TWO SECTIONS—SECTION 1

Engineering and Mining Journal

McGraw-Hill Co., Inc. New York, March 23, 1918

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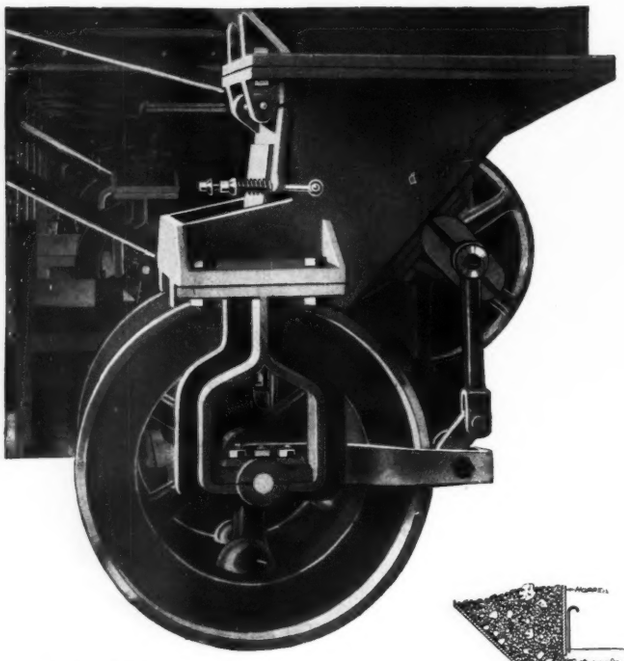

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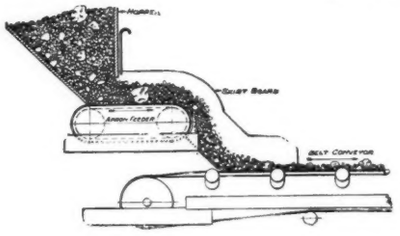

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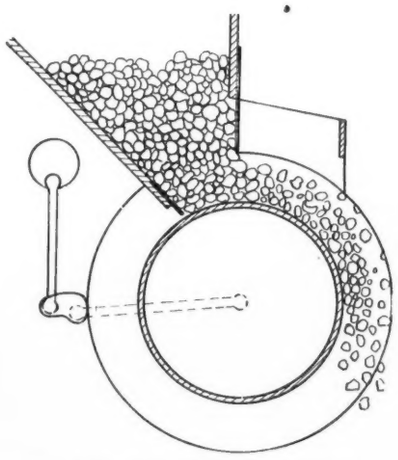

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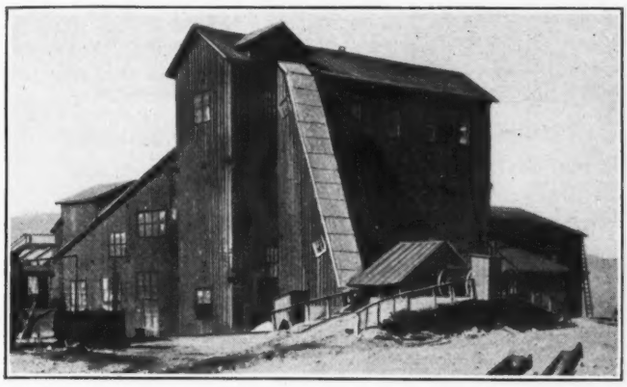
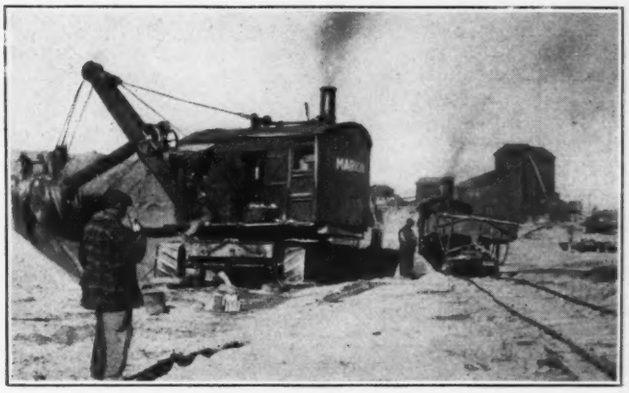




FLOTATION PLANT OF UTAH LEASING COMPANY, TAILINGS ARE EXCAVATED WITH A MARION SHOVEL

Utah Leasing Company's Flotation Plant at Newhouse, Utah

BY H. H. ADAMS*

The 700-ton flotation plant of the Utah Leasing Co. at Newhouse, Utah, is reworking the tailings dump of the South Utah Mines and Smelters.

Concentrates running 18% copper are produced from the tailings, which average 0.70% copper. The tonnage available is estimated at 1,000,000.

EARLY in 1914 a lease was secured by the Utah Leasing Co. upon the tailings dump belonging to the South Utah Mines and Smelters, at Newhouse, Utah. The tailings were produced in milling ores extracted principally from the latter company's Cactus claim. The ore is described in Butler's paper, "Geology and Ore Deposits of the San Francisco and Adjacent Mining Districts." The concentrator of the South Utah Mines and Smelters, now fallen into disuse, consisted of two units of a total capacity said to have been 800 tons daily. The ore after passing through jaw crushers was reduced in successive stages by rolls until suitable fineness had been secured for jigging and table and vanner treatment.

The dump is situated upon a gentle slope and occupies a space about 1000 by 1800 ft., the long axis extending due east and west. The estimated tonnage was placed at 1,000,000. Of this amount approximately 100,000 tons consists of slimes, segregated from the sands. Flotation tests were made upon the tailings, and the results obtained indicated that good extraction could be made by that method of treatment. Tests proved that much better extraction could be made upon the sands, but that a small amount of slime could be treated with the latter without causing any detrimental effect. Careful sampling of the dump indicated that the copper content would average 0.70%. The amount of oxidized mineral in some parts of the sand deposit exceeds 0.10% and in parts of the slime deposit 0.30%. Best results were obtained by agitating the pulp mechanically, and the Minerals Separation type machine was decided upon. A screen test of average sands and slimes follows:

TEST I. SCREEN TEST ON TAILINGS IN DUMP AT NEWHOUSE, UTAH

Mesh	Sands %	Sands Cumulative %	Slimes %	Slimes Cumulative %
+ 4	0.5	.....	.....	.....
+ 8	5.5	6	.....	.....
+ 14	30	36	.....	.....
+ 28	29	65	.....	.....
+ 35	9	74	.....	.....
+ 48	7	81	.....	.....
+ 65	5	86	1.25	.....
+100	5	91	2.00	3.25
+150	4	95	6.50	9.75
+200	2	97	3.50	13.25
—200	4	101	86.25	99.50

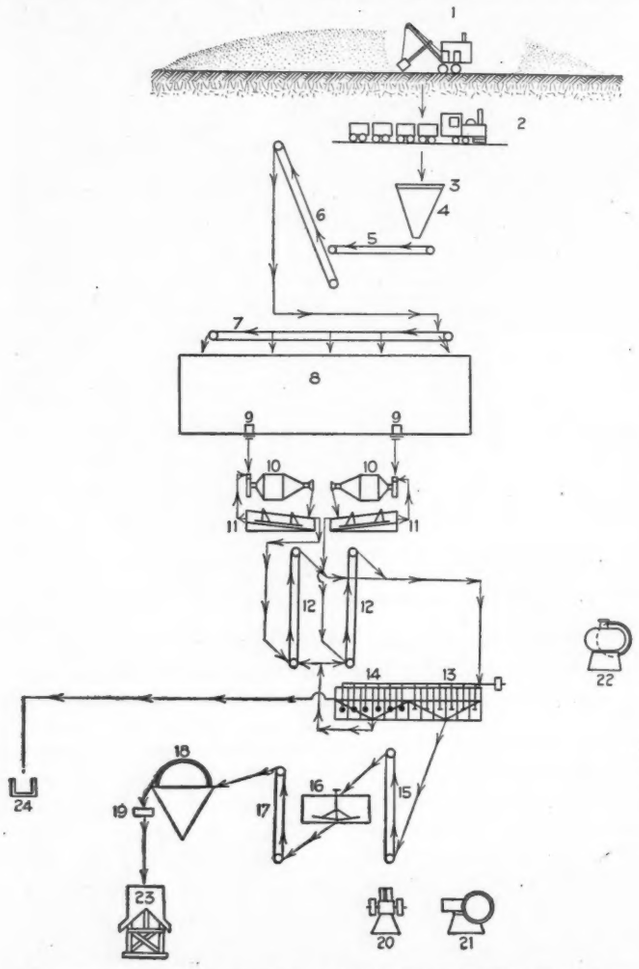
Work upon a concentrator designed to handle 500 tons per day was started in July, 1915, and, after considerable delay in securing material, it was completed and put in operation on Nov. 3, 1915. The flow sheet as originally planned is given in Fig. 1 and is very simple.

The new concentrator is situated at the northerly edge and about 500 ft. from the center of the dump. The main building is 55 x 112-ft. and of heaviest construction throughout. The sides are boarded with 1-in. material and covered with building paper. The roof is covered with heavy roofing paper. Sufficient heat

*Superintendent, Utah Leasing Co.

is furnished during the coldest weather by one large heating stove near the center of the mill. Other buildings included an office, a fully equipped assay office, a machine shop, a garage and two warehouses for flotation oils.

As the plant was originally constructed, the ore was hauled to the mill with a drag scraper operated by a double-drum hoist, which was geared to a 35-hp. constant speed induction motor. The ore was dumped upon a grizzly having 2 x 6-in. openings. The undersize passed to a 20-in. belt conveyor and thence to a 16-in.



ORIGINAL FLOW SHEET, UTAH LEASING CO.'S MILL

(1) 1 cu.yd. Marion shovel; (2) 15-ton locomotive and cars; (3) grizzly, 2 x 6-in. openings; (4) hopper; (5) 20-in. belt conveyor; (6) 16-in. bucket elevator; (7) 18-in. belt conveyor; (8) 600-ton bin; (9) Challenge feeders; (10) 8 ft. x 48-in. Hardinge pebble mill; (11) 4 x 16-ft. Dorr duplex classifier; (12) 16-in. bucket elevators; (13) and (14) 6-6 Minerals Separation flotation machine; (15) 12-in. bucket elevator; (16) 10 x 22-ft. Dorr thickener; (17) 12-in. bucket elevator; (18) 8 x 6-ft. Oliver filter; (19) 12-in. belt conveyor; (20) Gardner Rix compressor; (21) Doak vacuum pump; (22) Roots blower; (23) concentrates bin; (24) Tail race.

bucket elevator discharging into a 600-ton ore bin. The drag scraper, however, was unsatisfactory, and was replaced by a small steam shovel with a small engine and cars. Ore is drawn from the bin through two Challenge feeders, each of which serves an 8-ft. x 48-in. Hardinge pebble mill, operating at 28½ r.p.m., working in closed circuit with two 4 x 16-ft. Dorr duplex classifiers.

The classifier overflow is elevated by two 16-in. bucket elevators to a 24-in. 6-6 Minerals Separation combination machine, of the overhead gear-driven type, belted to a 75-hp. motor. Agitators have a peripheral speed of 1085 ft. per min. The first six cells of this machine produce a finished concentrate and the six final cells a middling product, which is returned, without further grinding, to the head of the machine for retreatment, the tailings going to waste. The concentrates pass to a 12-in. bucket elevator and then to a 22 x 10-ft. Dorr thickener; the underflow from this thickener passes to another 12-in. bucket elevator and thence to an 8 x 6-ft. Oliver filter. The overflow from the thickener, also the filtrate, is returned to the circuit. The filtered concentrates are discharged upon a 12-in. belt conveyor and thence into a concentrates bin. Concentrates are loaded into wagons and hauled to the railroad, a distance of 1500 feet.

Additional Flotation Machine Installed

Upon starting the plant it was found that the two Hardinge pebble mills did not have sufficient capacity to break down 500 tons of ore per day to pass 65 mesh, as anticipated, but on account of market conditions it was deemed advisable to slight grinding for the sake of tonnage. It was also found that the flotation machine would not do as efficient work as contemplated, and in the summer of 1916 a 24-in., 9-cell, standard Minerals Separation machine was added. The tailings from the 12-cell machine pass directly to the 9-cell machine, thus forming, to all intents and purposes, a single unit of 21 cells. Practice was then modified to the extent of making a finished concentrate from the 12 cells of the first machine and a middling product from the nine cells of the second machine.

In the spring of 1917, the daily output was increased to 700 tons, by adding an 8-ft. x 30-in. Hardinge ball mill. This machine is operated at 23½ r.p.m. The feed for it passes through two rotary feeders to a 20-in. belt conveyor and thence to the mill, which works in close circuit with a 6 x 20-ft. special Dorr duplex classifier. The overflow from the classifier passes to a 16-in. bucket elevator and thence to the head of the 12-cell flotation machine. Additional settling capacity for concentrates was provided at the same time, consisting of one 10 x 22-ft. and one 12 x 50-ft. Dorr thickener. At the same time, the six Hebbard-type cells of the first flotation machine were altered to the standard-type cells.

At the beginning of operations an acid circuit was used, but without satisfactory results. A neutral circuit was tried later, and best results were obtained by using an oil mixture consisting of 50% kerosene, 27% crude turpentine and 23% soft wood creosote oil. This reagent was used at the rate of 0.7 lb. per ton of ore. Approximately 75% of the total amount of this oil mixture was introduced into the circuit at the head of the grinding machines. The reagent gave concentrates of a very high grade, lot shipments running as high as 26.6% copper.

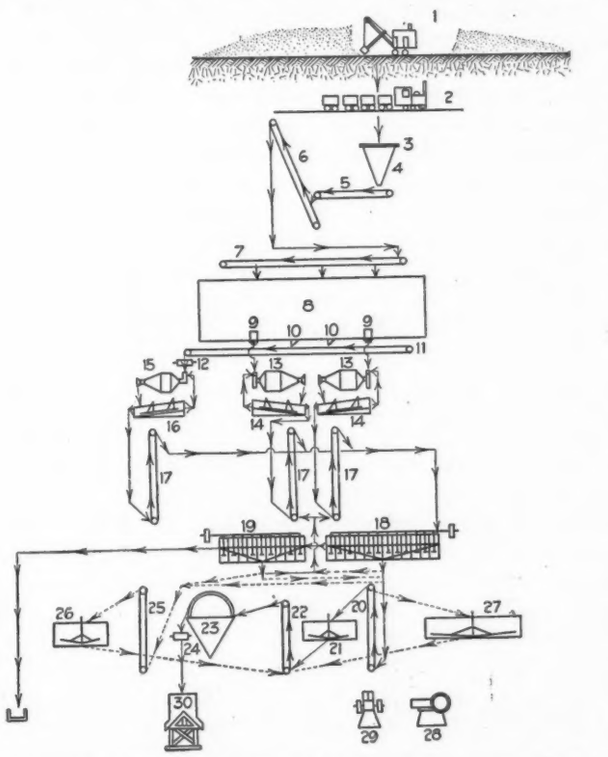
Best Results Obtained With Alkaline Circuit

Tests were made later in an alkaline circuit that proved so favorable that a permanent change was made. Crude soda ash is now introduced into the circuit at the head of the grinding machines at the rate of 10 lb. per ton of ore, along with an oil mixture consisting of 85% coal tar and 15% coal-tar creosote. Sufficient crude turpentine is added at the flotation machine to promote suitable frothing conditions. Crude soda ash is dissolved in metal tanks of 100 gal. capacity, the solution flowing by gravity into the feed boxes. Oil is fed to grinding

machines at a rate of 0.7 lb. per ton of ore by three small, chain-type, bucket elevators from a 50-gal. metal tank. Oil is first mixed and heated in a 100-gal. metal tank and then drawn off into a smaller tank containing the elevators above referred to. Buckets of 3, 5, and 10-c.c. capacity are readily attached to the chain, and thus the amount of oil may be varied to suit conditions. An electric heating coil is installed underneath each drum. Crude turpentine is fed into cells Nos. 1 and 7 of the first machine and cell No. 1 of the second machine by mechanical feeders of the revolving-disk type.

Power Used Transmitted Sixty-five Miles

All machinery is electrically driven. Power is furnished by the Beaver River Power Co. from its plant in the Beaver Mountains, 65 miles southeast of Newhouse. The current is delivered at the plant at 44,000



PRESENT FLOW SHEET, UTAH LEASING CO.'S MILL

(1) 1 cu.yd. Marion shovel; (2) 15-ton locomotive and cars; (3) grizzly, 2 x 6-in. openings; (4) hopper; (5) 20-in. belt conveyor; (6) 16-in. bucket conveyor; (7) 18-in. belt conveyor; (8) 600-ton bin; (9) Challenge feeders; (10) rotary feeder; (11) 18-in. belt conveyor; (12) 18-in. cross conveyor; (13) 8 ft. x 48-in. Hardinge pebble mill; (14) 4 x 16-ft. Dorr classifier; (15) 8 ft. x 30-in. Hardinge ball mill; (16) 6 x 20-ft. Dorr classifier; (17) 16-in. bucket elevator; (18) and (19) 12-cell and 9-cell Minerals Separation flotation machines; (20) 12-in. bucket elevator; (21) 10 x 22-ft. Dorr thickener; (22) 12-in. bucket elevator; (23) 8 x 6 ft. Oliver filter; (24) 12-in. belt conveyor; (25) 12-in. bucket conveyor; (26) 10 x 22-ft. Dorr thickener; (27) 12 x 50-ft. Dorr thickener; (28) Doak vacuum pump; (29) Gardner Rix compressor; (30) concentrate bin; (31) tail race. Dotted flow lines show possible and emergency arrangements.

volts and stepped down to 2200 and 440 volts respectively. Generally speaking, motors under 20 hp. capacity operate at 440 volts and those above at 2200 volts.

Water for mill use is piped from Wah Wah Springs, eight miles due west of Newhouse, across the Wah Wah Valley and thence well up into the foothills of the San Francisco Mountains to a concrete reservoir of 200,000 gal. capacity. The pipe line is constructed of 12-in. spiral-riveted pipe with bolted-joint connections. The line, as laid, is in the form of an inverted siphon, and a part of it is subjected to 200 lb. pressure per sq.in. The pipe is buried underground for a depth of two to three feet, and at points where there is much alkali in the soil deterioration has been rapid. Much trouble has been experienced in maintaining this line, and it is frequently necessary to drain it to make repairs. An emergency supply pond of a capacity of about 700,000 gal. was provided for conserving waste water from the reservoir, and connection made with the main leading from the reservoir to the mill. The line is patrolled daily by a repair man, a small motor truck being provided for this purpose.

The concentrates produced run 18% copper, the flotation tailings containing, on an average, 0.2% copper. Precious metals contained in the concentrates are: silver, 2.5 oz. per ton; gold, 0.08 oz. per ton. The moisture in the filtered concentrates averages 21%, and during the winter season runs as high as 26%. All concentrates are shipped to the International Smelter, at Tooele, Utah.

The mill feed now consists of 75% sand and 25% slime. As stated, the slime is segregated from the sand, and it is scraped up by team and loaded from traps into dump-bottom wagons. Two teams scraping and two teams hauling will deliver to the mill from 160 to 180 tons daily. Because of the arid climate, little interruption in delivering the ore to the mill is experienced. The total rainfall seldom exceeds 10 in. per year.

Local Quartzite Used in Pebble Mills

At the beginning of operations, Danish flints were used as the grinding medium in the pebble mills. The use of these was later discontinued, as a quartzite picked up on the desert near the plant gives practically as good results and at greatly reduced cost.

Attempts have been made to sulphidize the oxidized mineral in the ore, but without success, probably due in a measure to the brief treatment period afforded the pulp in the flotation machines. Experiments with a laboratory machine in which the treatment period lasted from 30 to 40 min. proved successful. The density of the pulp in the mill circuit varies from 28% to 30% solids. A screen test of feed, pebble, ball-mill and classifier discharge and flotation tailings is given herewith:

TABLE II. SCREEN TEST OF MILL HEADS, ETC.

Mesh	Feed		Nos. 1 and 2 Mills		Nos. 1 and 2 Classifiers		No. 3 Mill		No. 3 Classifier		Flotation Tails	
+ 8....	5	...	..	...	..	...	..	...	....	...	....	...
+ 14....	13	18	2	...	..	...	1	...	....	...	....	...
+ 28....	18	36	2	4	..	...	4	5	....	...	....	...
+ 35....	12	48	4	8	2	...	7	12	0.5	...	0.5	...
+ 48....	13	61	10	18	6	8	14	26	2.5	3	3.5	4
+ 65....	11	72	13	31	7	15	15	41	11	14	11	15
+ 80....	4	76	7	38	10	25	7	48	10	24	7	22
+100....	4	80	14	52	21	46	9	57	11	35	11	33
+150....	5	85	18	70	19	65	18	75	21	56	10	43
—150....	15	100	30	100	35	100	25	100	44	100	57	100
% Solids.	95		59.0		26.4		74.5		31.1		28	
% Water.	5		41.0		73.6		25.5		68.9		72	

The original plant was designed by O. B. Hofstrand, of Salt Lake City, Utah, and the construction was carried on under his immediate direction.

Bromine Production in 1917, according to R. W. Stone, of the U. S. Geological Survey, amounted to 903,860 lb. Chief production was from Michigan, Ohio and West Virginia. There was a 24% increase in production over 1916. The price of bulk bromine in 1913 was 25 to 35c.; in January, 1917, it was $1.40 to $1.50 and it is now 60c. per lb. The productive capacity of the existing plants is so large that much more bromine can easily be made.

Smelting and Ore-Sales Investigations in Colorado

Methods of sampling and ore purchasing in Colorado were reviewed by O. R. Whitaker for the investigating committee authorized by the State Assembly; he also presented some of the principal factors affecting the operation of lead-smelting works, ignorance of which is chiefly responsible for the criticism and suspicion which the miner in many instances still has for the smelter.

THE report of O. R. Whitaker to the Smelter and Ore-Sales Investigation Committee of the State of Colorado has already been commented upon in the *Journal*, especially with respect to the general financial returns which the lead smelters had received during the five-year period under review, 1912-1916. In the accompanying table are given the tonnages of Colorado ores treated annually in the lead-smelting plants of the state, together with the average charges or deductions for the various metallurgical operations. It will be recalled that the report showed a total of 3,140,018 tons treated in these plants at an average operating profit of $1.56 and, after allowing 61c. per ton for depreciation, interest, taxes, etc., a net profit of 95c. per ton in smelting Colorado ores during the five years. The net profit on the turnover of the period was estimated by the committee to be 3.72% per annum; figured on the present cash value of the smelting plants, it was 27% per annum. The several smelting companies protested against the use of the present cash valuation of the plants as unfair, citing the expenditure of capital on experimental plants, the abandonment of old units for new methods of treatment, etc., all of which do not appear in a current inventory.

COLORADO ORES TREATED IN COLORADO LEAD-SMELTING PLANTS

Year	1912		1913		1914		1915		1916	
Colorado ores smelted, tons	635,409		672,361		647,003		584,345		600,900	
	Ave. Per Ton	Per Cent. of Total Value	Ave. Per Ton	Per Cent. of Total Value	Ave. Per Ton	Per Cent. of Total Value	Ave. Per Ton	Per Cent. of Total Value	Ave. Per Ton	Per Cent. of Total Value
Credits:										
Gross metal value, 100% contents, N. Y. delivery	$26.33	100.00	$25.41	100.00	$24.02	100.00	$27.34	100.00	$31.63	100.00
Paid shipper and freight	17.62	66.92	16.87	66.39	16.19	67.40	18.76	68.62	20.59	65.10
Apparent margin	$8.71	33.08	$8.54	33.61	$7.83	32.60	$8.58	31.38	$11.04	34.90
Deductions:										
Smelting	$4.03	15.31	$4.21	16.57	$4.40	18.32	$4.48	16.39	$4.68	14.80
Metal losses	1.29	4.90	1.15	4.53	1.12	4.66	1.22	4.46	1.94	6.13
Refining, marketing, and freight on bullion and matte	1.80	6.83	1.54	6.06	1.63	6.78	1.47	5.37	1.86	5.88
Total deductions	$7.12	27.04	$6.90	27.16	$7.15	29.76	$7.17	26.22	$8.48	26.81
Annual operating profit	1.59	6.04	1.64	6.45	0.68	2.84	1.41	5.16	2.56	8.09

Average operating profit per ton for the five-year period $1.56
Average net profit per ton for the five-year period, after allowing 61c. per ton for depreciation, interest, taxes, etc ..... .95

Net profit on the turnover ..... 3.72% per annum
Net profit figured on present cash value of works ..... 27.00% per annum

The average content of the Colorado ores treated in the lead smelteries during the five-year period was: Gold, 0.526 oz.; silver, 12.34 oz.; copper, 0.61%; lead, 6.76%. Thus to reach a 12% lead tenor—generally recognized as necessary for good metallurgical work—outside ores must be imported to assist in the smelting of the average Colorado ore.

Recommendations are made in the report for the simplification of the smelting schedules. Apparently much of the feeling against the smelting companies in Colorado—and elsewhere—has arisen from lack of a complete understanding, on the part of the miner, of the somewhat complex methods of ore purchase. Mr. Whitaker in his report to the committee of investigation presented numerous charts and smelting schedules, and reviewed at length the whole question of ore purchase, the desirability of certain types of ores, the reasons why some ores are more expensive to smelt than others, and why some are penalized with extra charges or deductions. These matters are but faintly appreciated by the small mine operator, and excerpts from Mr. Whitaker's report, which should clarify the mine operator's view of the smelter's real position, are presented herewith.

Sampling Methods at the Mills and Smelteries

The several companies engaged in the purchase of custom ores in Colorado maintain their own sampling departments. The ores, as received, are sampled, and the results obtained form the basis on which the settlements are made. The methods of sampling used at the various plants are in accord with well-regulated practice throughout the country, and consist (1) of fractional selection by shovel or wheelbarrow sample, coning and quartering for sample, or (2) of automatic sampling. Use is made of each of these methods separately or in combination, as the circumstances permit, and depending upon the material to be sampled.

The custom gold mills determine the moisture in the ore by a moisture sample from the ore, in the process of crushing and sampling, after being crushed to ¾-in. size, from which 5 lb. is taken and dried. The usual practice of the smelting companies in determining the moisture in the ore it to take samples from pits dug in each end of the car or to sample the exposed faces while unloading. From a portion of these samples, moisture is determined.

At each plant provision is made to accommodate the shipper's representative for the inspection of the sampling throughout the entire process, and he selects a duplicate for independent analysis. Assays of the pulps of each lot are usually made by the shipper and buyer of the ore, and by a system of comparing results, as agreed upon in the contract, the settlements are made. Should the assays and analyses agree within splitting limits, the average is taken. The customary splitting limits as usually agreed upon in the ore-buying con-

tracts are as follows: Gold, 0.02 oz.; silver, 0.50 oz.; copper, 0.50%; lead, 0.50%; zinc, 1%; iron, 1%; insoluble, 1%; sulphur, 1 per cent.

The buying and selling of ores and metallurgical products, like any other industry, has but one object in view, that is, to show a profit on the business done. It is a commercial transaction in which each party uses the knowledge he has in the protection of his interests. The custom mill operators and smelters have always a clear knowledge of the results of their operations, such as cost of production, treatment, recovery, losses and the price of the product, from which they figure how much will be made on each ore purchase. The producers and sellers of the ores are possibly not so familiar with the details of the treatment processes used, therefore a clear explanation of the contract would be of great assistance to them.

Since the reduction plants, such as mills and smelteries, are built solely for the business of ore treatment, it is necessary for the companies when purchasing ores to charge the producers with the total cost of treatment, metal losses, refining, marketing, depreciation and interest, in addition to their own profits. In determining the ultimate profits on the business, the time between the settlement for the ores of the producer and the realization on the product is important. Where large stocks of ores are carried at the plant and the amount of refined or semi-refined product in transit is large, sudden variations in the market price of the metals have a decided effect on the increase or decrease of the profits. In times of high metal prices, ore production is stimulated and stocks are consequently increased. With a low metal market the reverse is true. Also, except under abnormal conditions, the market declines more rapidly than it rises. Therefore, unless some provision is made for the protection of the purchaser of ores carrying metals which fluctuate in price, a loss is more likely to occur than a gain.

The Advantage to Smelting Works of Definite Ore Tonnages

Ores are purchased in the open market as offered at the terms agreed upon, and usually without obligation on the part of the producer as to quantity. Time contracts are often made with producers when special ingredients are supplied or a definite tonnage of ore is assured. With a treatment plant operating in or tributary to a substantial ore supply, it would be impossible to settle for and treat the ores from the various mines immediately on the date of receiving them. Therefore it is necessary to settle on some agreed basis.

No metallurgical process recovers all the metal values from the ores. Therefore, the payment for the full metal content at market prices cannot be expected. Deductions are made for treatment, losses, marketing, etc., and bonuses are paid where required, making necessary some form of ore-selling contract. The existing ore schedules are the result of a gradual evolution of the ore-purchasing business, and in some form or other take into account, by direct-treatment charges or metal deductions, the items of principal importance to the purchaser. Inasmuch as these schedules are drawn to cover, in one contract, the business of paying for the metals in the ore, the treatment, the losses in the treatment, the refining and selling of the recovered products, the bonuses and penalties and a protection to the purchaser from loss due to sudden market fluctuations, they are complex. In their use for calculating the value of an ore to a plant, a system of discounts and charges is necessary.

Simple Schedules for Gold Ores

Milling rates, or charges for milling ores treated by cyanide or other processes, are made on a comparatively simple basis. Usually a graduated charge is made for treatment, depending upon the grade of the ore, which may or may not include freight. The deduction for freight and treatment on the Cripple Creek ores is in proportion to the gross value and is governed by the assay.

Schedules for the purchase of ores to be treated in concentrating and separating plants are complex in that they are used to calculate the price to be paid for ores containing several metals. These schedules usually start with a base price for ores of a certain metal content at a fixed market price and stated delivery. Unit variations are added or deducted according to the grade of the ore, and market variations are also allowed and . . . are calculated from a stated quotation given in the contract. The gold and silver are usually paid for at a certain price per ounce within specified limits. There is usually no direct treatment charge made in the purchase of these ores. The cost of treatment, metal losses, etc., together with the profit, are made up from deductions from the various metals contained.

Schedules for the purchase of zinc ores are made up from a base price, at a given market for ores of a specified grade. Unit and market variations are according to grade and metal quotations. The deductions made provide for the treatment, metal losses, etc., and the profit to the smelter. For the operations of the Colorado zinc plants, zinc ores containing gold and silver are preferable, and a similar schedule to that used by the separating plant would apply.

Lead-Smelting Schedules Cover Many Factors

Schedules for the purchase of ore for the copper-lead smelteries are complex, and must, in some form or other, provide for the cost of labor, fuel, metal losses, marketing, refining, depreciation, profit, etc. In order to cover these items the smelter usually pays for a percentage of the actual contents of the ore at a price below the market quotation. For gold ores, or gold in ores treated, no payment is made for a gold content of 0.03 oz. or lower, and in some cases of 0.05 oz. or lower per ton. Also a price of $19 to $19.50 per oz. is paid for the gold, as against actual value of $20.67 per oz. These two deductions are intended to cover loss in smelting, etc. For silver ores, or silver in ores treated, payment for 95% of the silver contents is usually made, and, in cases, no payment is made if ore contains less than 1 or 2 oz. per ton. These deductions are intended to cover smelting losses, marketing, etc. For copper in lead ores or copper ores purchased for treatment in lead smelteries, a deduction of from 1 to 1.5 units is made (to determine dry copper content of the ore) from the wet assay, and payment made for the balance at the quotation, less 3 to 6c. per lb., depending on the grade

of the ore... For lead in ores purchased for treatment in the smelteries the payment is made by deducting from the wet assay from 1 to 2 units and the balance paid for on the "unit and quotation" system.

The quotation used as a basis of settlement is generally figured as follows, from the New York sales price of the American Smelting and Refining Co. on date of settlement: When the sale price does not exceed $4 per 100 lb, take 90% of the sales price. When it does exceed $4, add to $3.60 per 100 lb. one-half of the excess of the New York sales price above $4. The prices paid per unit for lead in all ores and concentrates are based upon a quotation of $4 per 100 lb., 1c. up or down for each change of 5c. in the quotation.

Let P = price in cents paid per unit of dry lead in ore.
B = base price per unit (see table in schedule).
Q = quotation for lead, New York delivery.

Then

$$P = B + \frac{\$3.60 + \frac{1}{2}(Q - \$4) - \$4}{5}$$

for Q above $4 per 100 lb.

$$P = B - \frac{\$4 - (Q \times 90\%)}{5}$$

for Q under $4 per 100 lb.

For ¾ excess substitute ¾ for ½ in the above formula.

These deductions are made to cover the losses, marketing, refining, etc., and the excess deduction as a protection for the purchaser against sudden market fluctuations.

Custom Mills Handle Ore of Only One District

The custom milling and separating industry in Colorado is usually confined to a certain district, producing the kind of ore desired, or in the preparation of complex ores for the market. In most cases a part or all of the output from these plants is shipped and sold to the smelters. The custom-mills operators of Cripple Creek are competitors of the smelters in the purchase of high-grade siliceous ores up to the requirements of the latter for that class of ore. The concentrating and separation plants purchase ores of a complex nature and by separating the various metals market them to the smelters under more favorable conditions. The supply of this class of ore is generally more than the requirements of the smelters, therefore except in the case of special analysis there is no competition in purchasing. The financial results from operating a separating plant are variable, depending upon the properties of the ore. Ores containing equal quantities of like metals often yield entirely different results on treatment. Outside companies purchasing zinc ores and concentrates compete with the Colorado zinc plants, and the prices paid by the latter are usually governed by those offered by the former. The situation of an ore-treatment plant is determined by economic conditions. The success of a method of treatment depends wholly upon the profit and not upon the scientific possibility. There are many factors which enter into the essential requirements for a successful treatment plant, such as suitable supply and the metallurgical behavior of the ore. The conditions governing the ore supply and operations of the custom mills and separating plants are much simpler than those of the smelteries.

The main requisites for a zinc smeltery are cheap ore and cheap fuel. Where byproducts are made, marketing facilities are also important. The zinc smelteries in the natural-gas fields have cheap fuel; the Missouri and Oklahoma ores are higher in grade and cheaper to produce than the Colorado ores and are more desirable for a zinc smeltery. Owing to the increased cost of operation in Colorado, only crude ores of special composition are available, mainly impure complex zinc ores carrying gold and silver. The losses in zinc smelting are high and fuel consumption is heavy. The usual practice figures a loss of 8 units of metallic contents and from 2½ to 3 tons of fuel per ton of ore smelted. Losses in percentage would vary from 12½% on a 64% zinc ore to 25% on a 32% ore. These losses are due to absorption by retorts (which is not recoverable), impurities, burning of zinc, and the formation of non-recoverable compounds. The deduction for freight would depend upon the situation of the plant. Treatment charges will vary from $16 to $22 per ton of ore.

The essential requirement for a lead smeltery is an ore mixture to be so apportioned that a slag can be formed from which the recovery of the metal is readily made. The metallurgist may often have to sacrifice good practice to obtain the greatest profit. Barren fluxes not only cost money but also take up space and reduce the capacity. When fluxes contain metals of value, they may be classed as a low-grade ore and treated accordingly. These low-grade ores may be purchased under special and variable rates, according to the requirements of the plant. The slag formed from smelting an ore or a combination of ores will contain appreciable amounts of gold, silver, copper and lead, as well as the other constituents, no matter whether all the original ores contained these metals or not.

In smelting sulphide ores, roasting is necessary in preparation for the blast furnace, thus involving an extra expense of operation and an increased metal loss due to volatilization. The quantity of fuel required varies from 8 to 12%, depending upon the amount of sulphur, the lead on the charge, and the temperature of the formation of an easy-running slag.

Retreatment of Byproducts Increases Metal Losses in Lead Smelting

The principal products from the blast furnace are slag, flue dust and fumes, matte, speiss and bullion. All of these products contain metals and, with the exception of the slag, must be retreated for their recovery. When the ores contain small amounts of copper, as in the case of smelting lead-copper ores, retreatment is necessary to bring the copper into a marketable form for further concentration. Each stage of the treatment involves the usual losses, so that the ultimate recovery is relatively small.

The final recovery of lead from the ore in the average copper-lead furnace charge requires from 1¼ to 2 smeltings. For the recovery of the copper, in the form of high-grade matte, 2½ to 3 smeltings are required. In cases where the amount of lead on the charge is small, in the first operation, the recovery in bullion will be about 65%; in byproducts to be retreated about 15%; lost in the slag about 10%, and 10% will be volatilized. Part of the latter may be recovered in baghouses, according to the plant equipment.

For the efficient collecting of the metals in a lead smeltery, the percentage of lead on the charge should be around 10%. In order to smelt locally to the best advantage the ores of the average lead content, such as produced, it is necessary to obtain lead from another source to bring the charge to the economic requirement. During the five years' operation from 1912 to 1916, the Colorado smelteries produced approximately 441,000 tons of lead bullion, 50% of which was recovered from Colorado ores.

Low-grade ores are frequently produced in the prospecting for high-grade ores and also incidentally to the production of the latter. A sliding scale of treatment and purchase of these low-grade ores is justifiable in order to stimulate production. The loss to the smelter in smelting the low-grade ores must be borne by the high-grade ore in order to bring the average to a reasonably profitable basis. Should this not be done, the operations would be on a smaller scale, with proportionately increased costs for both.

Low Rates for Regular Tonnages of "Clean" Ores

In order to operate a smeltery successfully the mixtures going to the furnaces cannot be varied from hour to hour. Therefore the smelters desire large and regular shipments. In consideration for a guaranteed supply of a definite tonnage at a fixed rate, concessions are made, and these shipments are purchased under more favorable terms than the small, irregular shipments. A small shipment requires as much work for the assaying and general charges as a large one, making the cost of handling proportionately higher.

In copper-lead smelting, zinc in the ore is detrimental. It decreases the fluidity of the slag and lowers the specific gravity of the matte, thereby interfering with the settling. Losses are also increased and furnace operations are hampered. All of the zinc in the ore is a loss to the lead smelter, and the slag from Colorado smelteries carries from 5 to 10% zinc. Other ingredients of the ore, such as alumina, manganese, lime and magnesia, act differently in the blast furnace and are penalized or credited accordingly. Iron is a necessary flux and has only that value to the lead smelter. It goes into the slag and cannot be economically recovered.

Metallurgical Losses in Lead Smelting

The best slags will contain from 0.002 to 0.005 oz. of gold and from 0.50 to 1 oz. of silver per ton; from 0.20 to 0.30% of copper, and from 1 to 1.50% of lead. In the usual blast-furnace practice with 8 to 10% lead on the charge, the slag made represents from 60% to 65% of the charge, or one ton of slag for each ton of ore smelted. The matte fall is held at about 10%. The matte will contain approximately: Gold, 0.05 oz. per ton; silver, 40.0 oz. per ton; copper, 10%; lead, 15%; zinc, 10%; and iron, 40%, together with other ingredients, such as silica, alumina, etc. The second matte contains 40% copper or better. The baghouse product will contain something like 40% lead, 10% zinc, and such other volatile metals as arsenic, antimony, cadmium, etc.

The losses incident to smelting are slag, volatilization, and adverse operating factors having a mechanical origin. Smelting operations often show a gain in gold due to the non-payment for gold when less than 0.02 to 0.05 oz. is contained in the ore. The loss in silver is in the slag and possibly there is also a small mechanical loss, provided for by paying for 95% of the silver content. The copper loss is in the slag. The lead losses are in the slag and in the flue dust. In usual practice the following summary of losses will be representative: Gold, 0.005 oz. per ton of ore treated; silver, 1 oz.; copper, 6 lb.; lead, 30 lb. per ton of ore treated.

Deductions Necessary After Ore Is Smelted

In addition to the actual metallurgical losses in the smelting operations, it is necessary that the schedule provide for the refining and marketing of the metals recovered. The cost of refining and marketing of the gold and silver is small and is charged to the lead bullion. A representative bullion-refining charge is $25 per ton, which includes freight, etc., or 1¼c. per lb. of lead. A representative refining charge on 40% copper matte is $40 per ton, including freight, etc., or 5c. per lb. of copper contained in the matte. The refining and freight charges for the copper in lead ores are not to be compared with similar charges for the copper in an ore when sold to a copper smelter, as the latter ships a practically pure product, paying no freight on impurities. A lead smelter ships 40% copper matte, and the freight for the same distance, other things being equal, would be 2½ times as great.

A comparison of the open schedules with the average contract schedule, under which the bulk of the ore is purchased, would not be favorable to the shipper, because a contract for a guaranteed tonnage of ore of a desired content at a specified rate would be given advantages over the open schedule, which represents small and intermittent shipments. . . .

Purchase on the "Unit and Quotation" System

The method of payment for lead in ores used in Colorado is the "unit and quotation" system. The payment for the amount of lead in the ores is made on the basis of the fire assay. This is figured by deducting 1.5 units from the wet assay for lead. The use of the fire assay for determining the lead in an ore is only approximation; the inaccuracy is increased by overheating and the presence in the ore of other metals. It may be used for the quick determination of the lead in slags where the ratio of inaccuracy is known and can be readily applied. The wet assay for lead is the most reliable method used, and the results represent the lead content of the ores. Since furnace practice shows a loss of 30 lb. of lead per ton, a deduction for loss of 1.5 units is justifiable and should be made. This, however, does not mean that such a deduction would give the fire-assay results.

The fire assay for copper is seldom made, the wet assay usually being the basis for settlement. Furnace practice in treating copper ores in lead smelteries shows an average loss of 5 to 6 lb. of copper per ton of ore treated. The customary deduction of 1.5 units for loss is an arbitrary one and is governed by the quantity of copper ores received by the smelter during a definite period. Since copper is not contained in all ores received by the lead smelters, slag absorption will cause loss continuously, which must be provided for.

The non-payment for the metals below a certain limit

is intended to cover losses and give a commercial protection to the smelters. When these ores are smelted with ores carrying enough of the metals to take care of their proportion of the slag absorption and other losses, all the excess above these requirements is recovered. In ores containing under 5% lead, the lead is sometimes paid for as iron at 15c. per unit, but usually nothing is paid. In smelting this ore together with sufficient high-grade ore to bring the lead on the charge high enough for furnace requirements, all of the lead in excess of 30 lb. per ton would be recovered, according to general practice. The commercial reason for this deduction is that the lead content is below smelting requirements, and this ore can be treated to advantage only along with a higher grade lead ore. The limited supply of high-grade lead ores therefore controls the smelting capacity of low-grade lead ores. These low-grade ores are not profitable to the smelter for their lead content when considered by themselves, as they can be smelted only by recharging bullion into the furnace, to bring up the lead on the charge, thereby increasing losses and costs.

It is the custom of many public assayers to report to the miner the value of an ore as the sum of the various metals at their respective market quotations at the time the assays were made. This is decidedly misleading. Account must be taken of such factors as freight, treatment, refining, marketing the product and profits from treatment, in order to arrive at the ultimate return which the miner may reasonably expect. In figuring the value of an ore or a metallurgical product, the basis used should be the price per standard unit of quantity of the refined metals at some principal market center at the time the valuation is made. New York being the center used, then the value of an ore to the miner is the sum of the selling price of each metal at New York times its unit of quantity, less the combined cost and expense of treating the ore and marketing the products.

Smelting Companies Consider Physical Appraisal of Plants as Unfair

The foregoing observations from Mr. Whitaker's report deal with the general considerations in the purchase and smelting of the ores. In a summary of the smelting operations of Colorado, he placed a cash value of $2,700,000 on the lead-smelting plants of the state. The investigating committee sent a copy of Mr. Whitaker's report to the smelting companies and asked for comment or criticism thereon. Their principal point of criticism was concerning plant valuation. Extracts are here presented of the letter received from L. G. Eakins, general manager of the Colorado department of the American Smelting and Refining Co.:

Without discussing the report at length, we wish to suggest certain supplemental matters which should be considered in connection with Mr. Whitaker's figures as affecting the question of the average operating profit on Colorado ores during the period covered by the investigation. These are as follows:

1. In making his allowances for depreciation, Mr. Whitaker uses as a basis an estimate of the cash value of the several lead and copper smelting plants, and we believe we gave him these figures as to our own plants. We would, however, call your attention to the fact that smelting companies are obliged to figure depreciation not upon the actual cash value of the plants upon a given date, but upon the cost of these plants, which must include not only the original cost, but also the large sums expended from year to year in making replacements and improvements which are necessary to bring the plants up to date. While these expenditures may not in any way increase the actual cash value of the plants, as they in the main merely replace old methods of handling ores by new methods which are more efficient and economical, they must be considered as a part of the cost of the plants, as they are not included in current smelting costs and must in some form be charged against profits. It is evident, therefore, that, in order to avoid loss, the smelting companies must base depreciation charges upon a valuation very much higher than the estimated or actual cash value upon any particular date. For this reason the allowance for depreciation which Mr. Whitaker makes is very much less than the smelting companies must make in figuring profits.

2. The figures given in the report covering smelting costs are general averages based on the entire tonnage of local and foreign ores. A very large proportion, however, of the Colorado ores is of a refractory nature and requires roasting, thus materially increasing the cost of treatment. For this reason, the actual cost of treatment of the Colorado ores is higher than the average figures upon which Mr. Whitaker's report is based. While the actual amount of this excess cannot be determined, it is certain that it exists and that it is very considerable.

3. Mr. Whitaker calls attention to the fact that the output of lead ores in Colorado is not sufficient to supply the local plants and that it is therefore necessary to import lead ores in order to obtain the necessary percentage. As a matter of fact, only one of the Colorado plants of the American Smelting and Refining Co. can operate upon local lead; the others are obliged to use large quantities of lead ores and concentrates imported from other states. Without this outside supply it would be quite impossible to operate plants at Denver, Pueblo and Leadville, and the mining industry of the state would be seriously crippled. These outside lead ores are brought from mines at great distances from Colorado. If they were smelted outside of Colorado the Colorado miner would suffer; if they are brought to Colorado the large difference in freight must be paid by the smelting companies and not by the foreign shipper. This expense, therefore, must be considered in connection with the cost of treating Colorado ores and with the charges and deductions to be made in determining the profits realized therefrom.

Colorado Ores Inadequate as a Basis for Lead Smelting on the Present Scale

The Ohio & Colorado Smelting and Refining Co., which operates the smeltery at Salida, Colo., replied to the committee through General Manager Max Schott, who took up especially the effect on the smelting cost of importing rich lead ores to bring the average tenor of the furnace charge up to 10% Pb. The physical value of the plants is also discussed in his letter. He said in part:

Regarding O. R. Whitaker's report, I make free to call attention to the following:

The cost of smelting is arrived at by taking the total cost and applying as divisor the total ore smelted. This would be an entirely proper method if it were not for the fact that the Colorado ores smelted during 1912-1916 only carried 6.76% wet lead. The outside ores carried 32.65% wet lead. Mr. Whitaker, on page 140, properly states the following: "For the efficient collecting of value of a lead smeltery, the percentage of lead on charge should be around 10%."

On an average, the amount of lime rock charged in Colorado represents 20% of the total tonnage charged; therefore, in order to have 10% lead per ton of charge, the average contents of lead in the ore must be 12½% Pb. You will note from the report, that the actual average lead contents for the entire period, 1912-1916, is equal to 11.67% per ton of ore, or, in other words, the amount of lead charged falls short of good metallurgical requirements to the extent of 0.83% per ton of ore.

You will appreciate from these facts that the 6.76% lead carried by the Colorado ores is insufficient to smelt these ores and that in order to make possible an average lead content of 11.67%, there was added from foreign ores 4.91% Pb per ton of Colorado ores treated. This additional lead must be shipped, refined and marketed. The cost covering these three items would not be necessary if Colorado ores carried the required amount of lead.

Using Mr. Whitaker's method of arriving at the cost of shipping, marketing and refining, I get the following: Amount of lead added is equal to 4.91%, which is equal to 98.2 lb. of lead per ton of ore. Multiplying this by 1.25c. per lb. = $1.23, being additional cost of freight, marketing and refining.

At Salida about 70% of the total lead smelted is derived from ores produced outside of the state. Under normal market conditions this material cannot be laid down at Salida except at a heavy loss. Yet this loss must be incurred in order to make operations at Salida possible. It must be borne in mind, in this connection, that the Colorado plants are not lead smelteries in the ordinary sense of this term, but that they are essentially engaged in treating gold and silver ores and using lead and, to a limited extent, copper, as a collector for these precious metals. The lead is a necessary flux. Whenever the margin in the ores furnishing the lead is insufficient to cover the cost of treatment, plus marketing and refining, the deficiency must necessarily be added to the cost of treatment of the dry ores. . . .

Much Capital Put Into Smelting Works Disappears with Introduction of New Methods

Another feature of the report which should be considered in viewing the results obtained at the Colorado plants, is the item of "Physical Value of Plant." The report does not take cognizance of the fact that a great deal more money is invested in these plants than their present physical value. It is well to understand that in the nature of this smelting industry constant changes in installation and new construction are unavoidable. To illustrate: The Salida plant started operations in 1902. At that time the great part of the ore supply consisted of oxide ores. This condition did not call for an elaborate system for roasting ores. A few hand roasters took care of the amount of matte which was made.

Within a few years conditions changed and the company had to invest $145,000 for a hand-roaster plant and building. This plant consisted of 12 hand roasters. Eventually the product from these hand roasters proved a handicap to the operations because of its physical character, and besides this the cost of roasting by hand averaged $2.75 per ton of ore, making operations prohibitive. Some other system of roasting was essential to keep the plant going. The problem was to produce a sinter, coarse and porous, and to do this at a reasonable cost. The company carried on extensive investigations and experiments, resulting eventually in the installation of three Godfrey roasters, one Wedge roaster, and four Dwight-Lloyd sintering machines.

The Salida plant did the pioneer work in connection with the Dwight-Lloyd sintering process. This process has now been adopted throughout the United States. The hand-roaster plant was of no further use and has been dismantled, but this does not alter the fact that $145,000 was invested, which must be returned, plus interest, before there can be any profit.

I do not wish to take up time and space with a detailed recital of the many other investments, installations and changes which were made and abandoned for similar reasons. Altogether these investments, since replaced, represent at Salida many thousands of dollars, and the chances are that at the other plants in this state the situation in regard to this question of money invested versus physical value corresponds more or less to the situation at Salida. The fact is that at Salida the earnings have so far not admitted writing off anything for depreciation.

Discussing the recovery of byproducts by the smelters, Mr. Whitaker states in his report that there are two smelting plants in Colorado equipped with baghouses for the recovery of the volatilized material from the blast furnaces. That portion which is volatilized in roasting the ore is not recovered at any Colorado plant.

In addition to the recovery of gold, silver and lead from the flue dust and baghouse product, arsenic and cadmium are recovered at the Denver plant. The arsenic plant at Denver treats the flue dust and baghouse product from other allied plants. The maximum output of the plant is 120 tons per month of arsenic trioxide. The cadmium plant at Denver treats the baghouse product supplied from various smelting units of the American Smelting and Refining Co., many of which are operating outside the state. The maximum output of this plant is four tons per month. A small quantity of bismuth was produced from the Leadville plant.

The production of these byproducts is the result of the concentration and accumulation of the material treated. With the exception of possible special occurrences, these metals are probably associated with others, and the quantity in the original is so small that the extra expense of its recovery from the crude ores would not be justified, and no accounting is made of their value in the purchase of the ores for the smelteries.

Gold on Creeks in the Copper River Basin, Alaska

Alaska continues to be a good paying investment for Uncle Sam, its mineral output in 1917 having been more than $41,000,000, and, according to the U. S. Geological Survey, although the production of gold was somewhat reduced, the interest in the gold placers is still keen. Among the rich placer deposits are those of Valdez Creek, which have yielded gold valued at $375,000. Gold has been found in its bedrock source in the slate area south of Valdez Creek and is present in some of the stream-gravel deposits within that area. Most of the placer gold from this district, however, has come from an old gravel-filled channel or canyon once occupied by Valdez Creek and from the stream gravels of that part of the present channel of the creek which lies below the point where the old and new channels intersect. The gold in the new channel is in large part a reconcentration from the rich auriferous filling of the old canyon. The old channel and the three or four creek claims below it on the present stream constitute an excellent example of the importance of reconcentration in the production of rich gold placers.

Slate Creek is 75 miles east of Valdez Creek. It is the site of an older camp than Valdez Creek, and with its tributary, Miller Gulch, has been the greatest producer of placer gold within the Copper River basin, having yielded more than one and three-quarter million dollars. Diorite intrusive rocks are present, and in this respect the deposits resemble those of Valdez Creek. It is believed, however, that the slate of Valdez Creek is younger, although the diorite intrusives are probably of the same or nearly the same age.

Valuing Mining Property

By A. L. H. Street*

In a suit involving the value of mining property, the United States court for the District of Rhode Island recently decided that the purchase price of a claim, fixed in a contract for its sale permitting the buyer to pay in installments and to abandon his purchase without other liability than forfeiture of payments made, does not indicate the real value of the property. (Munro vs. Smith, 243 Federal Reporter, 654.) This decision is based on the conclusion that as payments are optional, and may be contingent upon uncertain success in developing the mine, the seller naturally demands a higher price, and the purchaser is willing to pay more, than in an outright purchase for cash.

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Methods of Valuing Oil Lands

By M. L. REQUA*

The determination of the value of an oil property requires the approximation of the ultimate total quantity of oil produced, the probable life of the resources, the total amount of money to be expended during the life of the property, the total gross receipts and the present value. By the study of production records and costs from a number of oil fields in California, production, cost and present value curves of a high degree of accuracy have been constructed, and from them the value of an oil property in any one of the oil fields covered can be calculated. The subject is an interesting one to engineers, particularly at present, as the valuation of mineral properties for Federal taxation is an important question.

THIS paper is abstracted from the report of the appraisement committee of the Independent Oil Producers' Agency, of which the writer was chairman. The other members of the committee were M. V. McQuigg, R. S. Haseltine, and Thomas Cox, engineer.

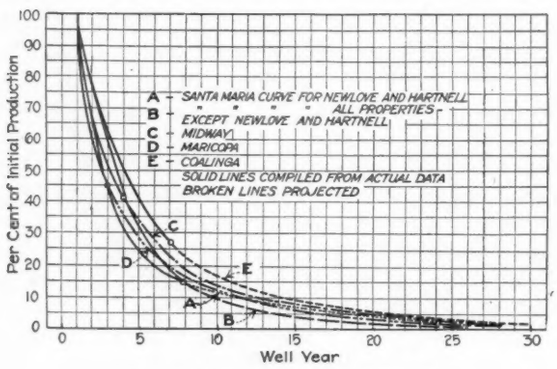

A – SANTA MARIA CURVE FOR NEWLOVE AND HARTNELL
B – " " " " ALL PROPERTIES
EXCEPT NEWLOVE AND HARTNELL
C – MIDWAY
D – MARICOPA
E – COALINGA
SOLID LINES COMPILED FROM ACTUAL DATA
BROKEN LINES PROJECTED
Per Cent of Initial Production
Well Year

FIG. 1. PRODUCTION CURVES

With these curves there is a certain volumetric content. This is used to estimate the total production of one well during its life by multiplying the initial production of the new well by 365 days, and by the figure shown as the volumetric content, which will give the number of barrels the well will produce to the 1-bbl.-per-day point of cut off. For example, on the Coalinga curve the volumetric content is 5.738. A 50-bbl. well would produce 50 by 365 by 5.738, which equals 104,718 bbl.

The other volumetric contents are as follows:

Kern river	5.5
Maricopa	4.452
Midway	4.976
McKittrick	5.738
Santa Maria (Except N & H)	4.3805
Santa Maria	4.2730
Fullerton	5.738

It treats only of the valuation of the lands, wells and piping, without going into details of equipment and other features.

It was recognized early in the operation that the value of oil lands was the value of oil to be extracted and marketed, less the costs attendant thereon. Referring this back to the costs in cents per barrel, it became obvious that surface improvements, absolutely necessary in the production of oil from wells then drilled, had no separate and independent value aside from the value of the land, but that any excess equipment not necessary for the production of oil from present wells, such as drilling tools, well casing, etc., should be given a present-condition value. In valuing the properties of the Independent Oil Producers' Agency, the committee considered the following facts:

1. That from each property there will ultimately be produced a certain total quantity of oil.
2. That in the production of that oil a certain total amount of money will be expended.
3. That a certain total amount of money will be received from the oil.
4. That the total net receipts will be the total gross receipts less the cost of development and production.
5. That the present value of the net receipts must be such an amount that when invested by a purchaser it will be returned with 8% interest additional during the life of the property.

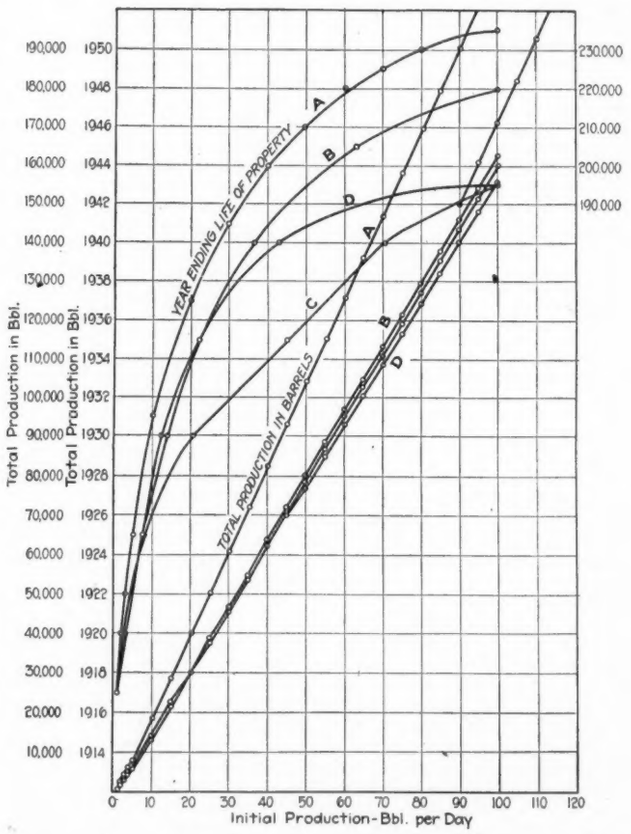


FIG. 2. THIS SHOWS BY DIRECT READING THE ESTIMATED PRODUCTION OF ONE WELL AND THE YEAR OF ENDING AT THE 1 BBL. PER DAY

Illustration: New well with initial production of 50 bbl. per day first year, read up to intersection of total production line, thence to the left and read 104,000 bbl. Going back to the 50-bbl. line and up to the intersection of the curve line, thence to the left, 1946 will be the year ending the production at the 1-bbl.-per-day point.

A = Coalinga curve. C = Santa Maria curve.
B = Maricopa curve. D = Newlove and Hartnell curve.

The initial procedure consisted in making a general reconnaissance of the entire district in which the property was located and determining the lithological and structural conditions underlying the area. The data obtained from each individual tract comprised the logs

*Head of Oil Division, Fuel Administration. Member Executive Committee, Independent Oil Producers' Association, Consulting Engineer, Bureau of Mines, on Petroleum. Excerpt of a paper presented at the St. Louis meeting of the A. I. M. E.

of all the wells, with the history of each individual well wherever it was possible to obtain it; also the total production from the property and from each well whenever such data were available. It was also necessary to make a complete inventory of all the surface equipment and estimate its present worth.

The next step consists in collecting enough production data to construct a curve for each district, showing the decline of an ideal well from its inception to its exhaustion. This was accomplished by obtaining all available information regarding the total yearly production for individual wells in each area and compiling it so that the average curve would be a compilation of the first year's production of all the wells, the second year would be a compilation of the second year's production of all

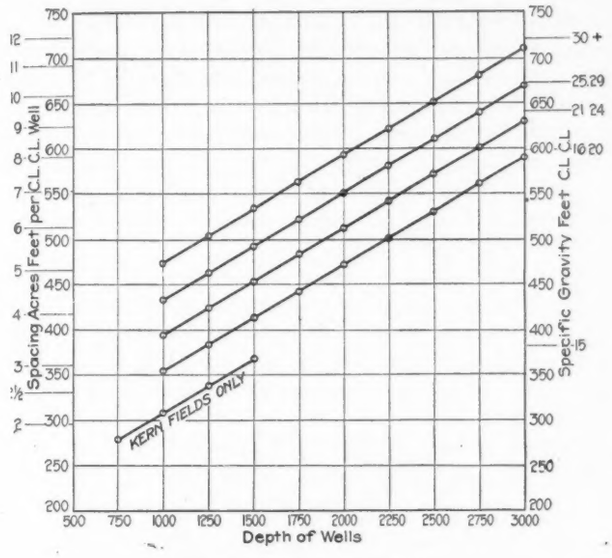


FIG. 3. WELL SPACING

the wells, and so on through the past years to date. These data, computed on a percentage basis, showed a constantly lessening decrement and this decrement was computed for the succeeding years. The results of the compilation of the data in each field are shown graphically in Fig. 1.

In the Coalinga field the monthly production of 86 individual wells was obtainable over a period of seven years. These data were arranged so that the resultant curve shown on Fig. 1 was a compilation of the first years, the second years, etc., of all the wells, according to the method previously stated.

As the Kern field is one of the oldest in the state and yearly production records were poorly kept, accurate data concerning its early history were not obtainable. It was found impossible to compile any data that would substantiate the results in Coalinga, but as the number of wells to be drilled was very small in comparison with the total productive area, and as the conditions regarding production approximate those in Coalinga field, it was decided to use the theoretical figures of the Coalinga curve in computing the production from new wells in this area.

In constructing a curve for new wells in the Maricopa district, the individual records of 29 wells were obtainable, and these figures were used to construct a curve by the same method as was applied in Coalinga. In the Midway district the yearly production records were obtainable from 24 wells, and a curve was constructed from these data. In two instances where flowing-well conditions existed, special curves were developed from records of wells in similar territory.

In the McKittrick field no data were available that could be used to construct a curve for an ideal well, and as the general conditions compared favorably with the Coalinga field, the Coalinga curve was used for this field. In the Santa Maria field the individual well production was obtainable from every well which the Union Oil Co. drilled, and as some of the wells have been producing for 10 or 11 years, excellent data were available. These were divided into two types and two individual curves constructed. One curve, which was used in computing the theoretical production from new wells on the Newlove and Hartnell properties, was compiled from the data on all the Union Oil Co. properties in the field. The other curve was constructed for use on the remaining properties and included the data on all the properties except the Hartnell and the Newlove. This method was pursued for the reason that the conditions regarding production on the Hartnell and the Newlove properties were dissimilar to those on the remaining properties in the field. In the Lompoc field the present wells have been widely spaced; therefore the decrease in production per well per day has been more gradual than would occur in an area of closer drilling. As these data, therefore, would not apply to a drilled-up condition, the Santa Maria curve, which excluded the Newlove and Hartnell production, was used, as the general conditions are similar to those of the Santa Maria field.

In Orange County no individual well data were available over any appreciable period. As the conditions of thick, saturated sands approximate those of Coalinga, the same decline was used for all properties with the exception of the Union Oil Co.'s Graham & Loftus lease, where a curve developed from the production of all wells drilled to date on that tract was used. In Ventura County no individual well data were obtainable, but as the wells were drilled, in most cases, 20 years ago, and the properties produced continuously over this period, the decline in production from the entire area eventually approximated that of one well, and the ideal curve was deduced from this data. Comparing the different curves on a percentage basis, the maximum deviation of any one curve from the average is less than 10%. This is one of the most notable facts brought out by this work.

Basis of Production Calculations

As an example of the use of these curves in the calculation of the production from the undrilled areas, suppose the new wells on a certain tract to have an assumed initial production over the first year of 100 bbl. per well per day, then the average production per well per day for the second year will be 79.7 bbl., as is shown in Fig. 1. The sum of all these figures, representing the average production per well per day, multiplied by 365, will give the total production from one well, and multiplied by the total number of wells will give the ultimate production from the undrilled area. For figures above or below 100 bbl., the total production will be in direct proportion.

Fig. 2 is a graphic representation of these calculations. The assumed initial production for new wells

is shown at the base of the chart and the diagonal straight line above shows the total production from one well. The curve line shows the year in which the average production per well per day will reach a production of 1 bbl. for varying initial productions. In computing the total production from each property, the following steps were taken:

1. To divide each property into two areas, drilled and undrilled.

2. To compute the total ultimate production from the drilled portion by constructing a curve which showed the average past production per well per day and projecting this curve for the future.

3. To compute the total recoverable content from the undrilled area, assuming that all development is completed in 1916 and maximum production occurs in 1917.

4. To combine the yearly estimates of two and three

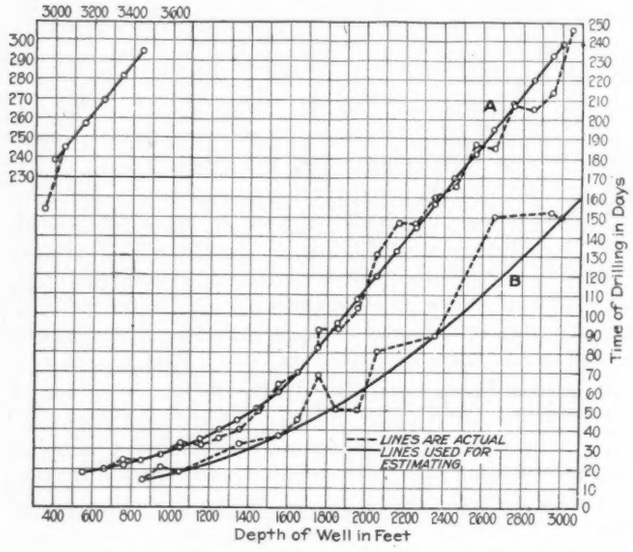


FIG. 4. AVERAGE DRILLING TIME FOR DEPTHS AS LISTED
A = Standard drilling, Coalinga, Midway and Kern fields.
B = Rotary drilling, Coalinga and Midway fields.

in each case as the total estimated production per year for the entire life of the property.

In order to divide the area into drilled and undrilled sections it was found necessary to construct a table showing definite well spacing for the varying conditions of depth, thickness of sands and gravity of the oil. The thickness of the oil sands underlying each property is undoubtedly a factor to be reckoned in the ultimate production per acre, but as in the majority of areas considered in the valley fields the sands are thickest in the shallow wells and thinnest in the deepest ones, this fact could be taken care of by judicious use of the chart. Since the gravity of the oil, as a general rule, varies from heavy, viscous grades in the shallow wells to light, mobile oils in the deeper ones, this also is taken into account. Fig. 3 was constructed by collecting and tabulating data on all the fully drilled up conditions of the properties in the San Joaquin Valley oil fields.

The well-spacing chart is constructed so that the spacing of wells from 750 to 3000 ft. (228 to 914 m.) in depth can be established. The varying depths are shown at the base of the chart and the spacing either in acres per well or the distance between wells is shown in the left-hand margin. The four diagonal lines are used for varying gravities. The lower line and the three succeeding lines for oils from 16° to 20° Bé; for 21° to 24°, inclusive; 25° to 29°, inclusive, and 30° and higher. The chart was used as follows:

From the logs of the wells in the immediate vicinity the average depth of the new wells to be drilled in the undrilled area was determined and the point selected on the diagonal line corresponding to the gravity of the oil to be obtained. Tracing this point horizontally to the left-hand margin, a figure is found which gives the spacing for this depth.

Drilling Time and Tool and Work Standards

Fig. 4, curve *A*, shows the time of drilling wells with a standard rig for varying depths. The data compiled include the results from over 700 wells of various depths in the Coalinga, Kern and Midway fields. The amount of casing used was established in uniformity with the practice on the properties considered. Fuel oil, tools, drilling lines, derricks, rig irons, belts, engines and haulage are all figured to standards. This method insures uniformity and is free from the variations which show on accounting records of the various companies. Curve *B* is constructed similarly for drilling time with a rotary jig.

Fig. 5 shows the cost of various sizes of pipe from 2 up to 8 in. in diameter and was constructed from actual data. These may be used in valuing lines already laid and in determining the cost of new lines for future development. They are compensated to include all necessary fittings.

To compute the total ultimate production from the drilled area, a curve was constructed showing the aver-

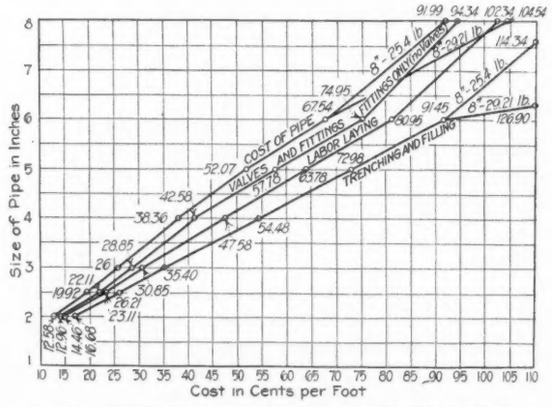


FIG. 5. COST OF OIL-FIELD PIPES LAID
(These prices do not include cartage. Valves not included above 6 in.)

age production per well per day for the property during the past years, and this curve was projected for the future by applying the percentage decrement in past production to the future. In the case where actual data were available showing that certain idle wells could be made to produce by redrilling or other repairs, or where the past production curve showed an abnormal decline, due undoubtedly to market conditions, it was adjusted to offset this decrease. It was imperative that all properties be valued on a relative basis, and as the present value of each would vary according to the time interval chosen for the drilling of new wells, it was recognized that some standard period must be adopted during which each property should be completely developed.

It is obvious, other conditions being equal, that if property "A" is completely drilled at once and its maximum production obtained immediately, it will have a much greater value than property "B," on which new development is deferred, and which is presumed to continue its present production at the normal rate of decline. The difference is due to the fact that the present value of one year's net receipts is smaller the longer its actual payment is deferred. In order to avoid these discrepancies and to treat all properties equitably, each has been theoretically drilled up in the year 1916. The maximum production, therefore, occurs in 1917, and during the succeeding years declines according to the established decrease curves until such a time as it is no longer profitable to produce oil from the property.

METHOD OF ASCERTAINING PER ACRE PRODUCTION

In computing the total recoverable content from the undrilled portion, the first step consisted in determining from the structural conditions the average depth of the wells to be drilled, and by the use of the well-

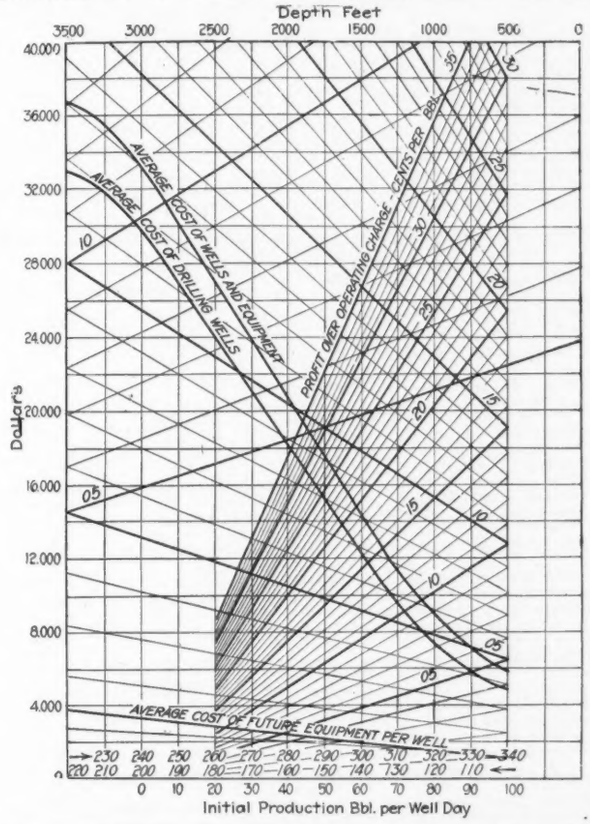

Depth Feet
3500 3000 2500 2000 1500 1000 500 0
40,000
36,000
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
Dollars
AVERAGE COST OF WELLS AND EQUIPMENT
AVERAGE COST OF DRILLING WELLS
PROFIT PER OPERATING CHARGE - CENTS PER BBL.
AVERAGE COST OF FUTURE EQUIPMENT PER WELL
230 240 250 260 270 280 290 300 310 320 330 340
220 210 200 190 180 170 160 150 140 130 120 110
0 10 20 30 40 50 60 70 80 90 100
Initial Production Bbl. per Well Day

FIG. 6. PRESENT VALUE OF NET RECEIPTS PER WELL OVER OPERATING COSTS WITH OIL AT 50c. PER BARREL (MINIMUM PRODUCTION PER WELL DAY, 20 BBL.)

spacing chart the number of new wells to be drilled. By dividing the ultimate production from the drilled area by the number of acres drilled, a figure is obtained which shows the total production per acre from this portion. The calculation of the future production from the undrilled area is based upon the past performance of wells in the immediate vicinity. Due consideration is given to lessened individual well production with complete development of the tract and to the total ultimate production per acre from contiguous drilled tracts.

Fig. 6 was made for estimating and is based on the Coalinga curve volumetric production of a well to the 2-bbl. point of decline, and is the amount that such quantity of oil will yield at the varying profits over the operating charges per barrel with all interest charges at 8%. The average cost of drilling wells and equipment is of all fields and is closely approximate for estimating purposes. For illustration, the average cost of future equipment per well where new wells have to be drilled, for a 2000-ft. (609-m.) well is $2400. This is meant to include extra pipe lines, proportion of electric equipment, etc. The drilling of such a well would be closely $18,200. Average upper line for both, $20,600. It is necessary to reduce the upper curve amount by 0.926 to conform to the deferred 8% basis of the calculation, which would be $19,076.

If the operating costs are estimated to be 28c., the profits will be 22c. for 50c. oil. At this value a line run horizontally to the 22c. line, then vertically to base, will show 68 bbl. This is the least initial production that such new wells must have in order to repay the cost and interest over the operating expense. Complete production and cost data were obtained wherever possible on properties that approximated fully drilled-up conditions and were not forced to curtail production on account of market conditions. This information was used as a guide to what might be expected from the surrounding properties in the immediate area. By reason of the inefficient system of accounting found to prevail with most companies, it was impossible to obtain any data of value relating to the costs of operating and developing on each individual property. If such data were available it would have greatly facilitated the compilation of future working costs. In computing the values the following steps were taken:

1. To estimate the future working costs per year from all data available.

2. To compute the net receipts per year, i.e., the difference between the gross receipts and the total yearly expenditures.

3. To compute the present value of each year's net receipts, allowing a specified interest of 8% per annum, and returning each year a proportionate part of the capital with 8% interest, thus obtaining the present value of the future production.

4. To add to this the salvage value of the excess equipment, thus obtaining the total present value of the entire property.

In making estimates for new expenditures and operating charges, standards were adopted and applied to all properties where conditions were similar. These standards were the result of careful investigation of present working costs of all kinds. In the case of new wells, drilling costs have been computed from all the past data available and are consistent according to fields and depths. The new equipment was also estimated according to the requirements of the property, the value being carefully computed from present-day prices as quoted by supply houses. These estimated expenditures were all charged and applied as of the year 1916, so that all new wells and equipment would be placed in that year for a maximum production in 1917.

In computing the annual cost of operation for the future, each item of labor and material was considered and charged according to the most economical method of operating, with due consideration for the present method in use on the property at the time of taking the

inventory. On properties having wells less than 1500 ft. (457 m.) deep, motor-driven jacks were considered the most economical form of power, and for properties having wells over 1500 ft. deep, those using gas engines at the present time were assumed to continue this method of operation throughout the life of the property, while those operated by steam engines in the past were changed to direct electric motor-driven installations, the assumption being that this latter method is the more economical.

The computation of the net receipts, and from this the present value, is purely mathematical. The table used for the computation of present value was taken from Hoskhold's *Engineers' Valuing Assistant.*

The surface equipment that can be given a present salvage value is all the equipment that can be removed from the property at the present time without interfering with its future operations. This includes drill tools, warehouse supplies, livestock, casing on the rack, mechanical equipment, etc. All other equipment, such as derricks, pumping plants, pipe line, etc., is considered in the allotment of expenditures for the future operation of the old wells; thus the operation of these wells will be carried on without the addition of any new investment. The net cost of operation per barrel, therefore, will be determined solely from operating costs and, consequently, will be lower than if an investment charge were necessary. The method adopted by the committee in the computation of values of the agency properties is considered to be far superior to any of the other methods proposed for the following reasons:

1. The history of development of the property as well as that of the adjoining properties is considered.

2. The operating cost is computed from actual figures obtained in the field, all necessary additions to plant being given full consideration.

3. In computing the present value of the actual net receipts for each year, amounts that can be redeemed with interest at 8% per annum are shown.

4. This method more nearly approximates the actual conditions that will exist in the future than any other method yet presented; is regular in its application to all properties and will give results that, when applied to a property, will admit of a fair and conservative return on the investment.

Six Real Savings

Far from being a handicap on business, war's demands for real economy are enabling business concerns, and particularly merchants, to turn unsuspected profits by sensible savings of material and labor. "System" gives these sources of economy profits:

Watching for needless words in telegrams and for needless telegrams.

Shifting hours of work a half hour earlier to cut down the light bill.

Routing traveling men more carefully.

Asking customers to coöperate in saving the time of sales people, in "bunching" their telephone orders, and in carrying home small packages.

Stopping the C. O. D. privilege for purchases of less than $1.

Guarding against waste in the wrapping and packing of merchandize.

Deferred Classification for Chemists

Owing to the disturbance in many essential industries, on account of important men being drafted, Government instructions have been issued relative to deferred classification of chemists. The letter and blank forms B and C, shown herewith, are self-explanatory. It should be borne in mind that these applications for exemption should be used only in cases where the employee is absolutely necessary for the practical operation of a plant or factory.

Form B is for chemists who are in the draft, and not in the Army or Navy service.

FORM B

Name of manufacturer.....
Address .....
Full name of chemist.....(Age).....
Address .....
A:—(To be filled in by manufacturer, not the chemist.)
Information regarding chemist:
1. Is he willing to receive deferred classification? (Yes.) (No.)
2. Serial No.....Liability No.....
Questionnaire classification—Class....Paragraph....Date....
Title and address of local board.....
.....
Has appeal for reclassification been made? (Yes.) (No.)
Date of appeal.....Result.....
3. Length of time chemist has been with your company.....
4. Proportion of total hours of the services of the chemist now spent on production* of war materials.....
5. Education (above grade of high school).....
6. Experience .....
Company .....Duration of employment.....
7. Nature of materials in the production* of which said chemist is engaged .....
8. Relation of above materials to the war.....
9. Statement of the importance of the chemist to the above war work by the officer in charge of the department.
Date .....Signed by.....
*Under production is to be included research, development and control work necessary to manufacturing operation.

Form C is for chemists who are at present in the Army or Navy service:

FORM C

Name of manufacturer.....
Address .....
Full name of soldier.....(Age).....
Camp address .....
A:—(To be filled in by manufacturer, not by soldier.)
Information regarding soldier:
1. Is the soldier in the Regular Army, National Army or Reserve Corps? .....
2. If the soldier is in the Regular Army or National Army, does he desire a discharge with reënlistment in the Reserve Corps (inactive list) in order to rëenter your employ?.....
3. If the soldier is in the Reserve Corps, does he desire to be placed upon the inactive list in order to reënter your employ? .....
4. Length of time soldier was with your company.....
5. Proportion of total hours the services of the soldier would be spent on production* of war materials.....
6. Education (above grade of high school).....
.....
7. Experience .....
Company .....Duration of employment.....
.....
8. Nature of materials in the production* of which said soldier will be engaged.....
9. Relation of above materials to the war.....
10. Statement of the importance of the soldier to the above war work by the officer in charge of the department.....
Date ..... Signed.....
*Under production is to be included research, development and control work necessary to manufacturing operation.

It is not necessary to secure copies of blank forms B and C. Simply make a typewritten copy of the forms as shown. In copying the forms, sufficient space should be left under each question to accommodate the answer, so that a longer sheet should be used than shown in the copy. The answers should be filled in with typewriter, using a different colored ribbon. The forms when filled out should be addressed to "Chief of Chemical Service Station, N. A., New Department of Interior Bldg., Washington, D. C."

Oil-Flotation Process and Apparatus has been patented by D. F. Haley (Canada, 177,625, June 12, 1917), involving the discharge at high velocity of a jet of pulp mixed with oil downward into a body of water, thus causing aëration and formation of a froth.

Malingering and Loafing

BY CHESLA C. SHERLOCK*

Injuries resulting from or occurring during industrial employment often induce conditions of mind or habits of work in the workman that seriously affect his right to ask compensation. Employers are often confronted with a demand for compensation when they are convinced that, in all justice, it is not due; and in some instances they face a condition when compensation, while apparently due, is not, as a matter of law, in order. Chief among the evil tendencies sometimes produced by an injury is malingering. A workman may be injured slightly and magnify the hurt to its greatest proportions in order to get compensation as long as possible. The malingerer is a cheater and a fraud. He knows that he is not hurt as badly as he would have his employer believe, but, for reasons of his own, misrepresents conditions. Medical men are confronted with malingering in all of its varying aspects and they are usually skillful in detecting it.

Hysteria is another form of mental condition produced by injury which may seriously affect the right to compensation. It is the exact opposite of malingering, in one sense. The injured workman steadfastly believes he is hurt badly and cannot return to work, when, as a matter of fact, he is not nearly so incapacitated as he imagined. One court explained the difference between a malingerer and a hysteric as follows: "The difference between a malingerer and a hysteric is that the malingerer claims disability when he knows that he has no right to do so, and the victim of hysteria claims disability in the unshakable conviction that he is disabled. In the language of Dr. McClenahan, an excellent authority on the subject, 'His injury is just as real to him as though it actually existed.'"

In a Wisconsin case, a workman refused to return to work when the attending doctor reported that he had recovered of his injury. The commisson said: "His symptoms are all of a subjective nature, such as headache, dizziness, deafness in one ear, impairment of sight in one eye, numbness of one leg, and the loss of memory. Repeated examinations and the application of suitable tests show that his claims are unfounded, with the possible exception of the claim that he suffers from headache, and, if he does have headache, there is no reason for contending that it is attributable to his injury. The applicant has made himself believe that he cannot work. From an active life he has gone to the extreme limit of absolute inactivity. It is little wonder that he feels weak and that his limbs tremble and he feels dizzy when he attempts to work. These symptoms naturally follow any physical exertion after such long-continued idleness. There is every reason to believe that his headaches, if such he has, are the direct result of his inactivity and that with his return to work will come his usual vigor and health." The commission held that it was apparent that the applicant's condition was of a neurasthenic character, and that, instead of being given compensation, the applicant should be encouraged to return to his regular work.

In a California case, a workman received a slight bruise on his leg. The Industrial Accident Board said: "Nevertheless, despite the affidavits and testimony of reputable physicians, corroborated by other evidence as to the conduct and bearing of the applicant while under observation, unknown to himself, the applicant has pretended to be seriously injured and to entertain great fear lest his leg never recover its usefulness. Whether or not this pretense of serious injury be feigned or the result of a morbid dwelling of the mind upon his injury, the conclusion is irresistible that his demand for further compensation is without merit. In short, the case under consideration belongs to that class of malingering or simulation which causes great concern to those who are skeptical in regard to the merits of compensation as a system for dealing with industrial injuries. Such cases are to compensation what arson is to fire insurance and fraud is to life insurance. They must be dealt with sternly and uncompromisingly, else they will bring into disrepute an institution which otherwise yields great hope for dealing effectively with a serious social burden."

Malingering may, as a rule, be easily detected, if the employer really exerts any effort to get at the truth in the case. The malingerer puts up a pose when in the presence of the compensation authorities or the insurance adjusters, but when the coast is apparently clear he relaxes and assumes his normal self. If he is watched closely enough and in such a manner as not to arouse suspicion, he can easily be caught in his deceit. In neurasthenic or hysteria cases, however, reliance must be made almost entirely upon medical testimony and that of experts. It is properly a nervous condition of the mind produced by the injury or aggravated by it, and is not easily determined, therefore, by the lay mind and should be left to the attention of the best medical experts.

Compensation should, of course, be paid in every case where it is justly due, but employers should be as alert as the insurers and the commissions to head off malingering before it reaches serious proportions. If a certain class of workman find out that Tom Jones has played sick, even though Tom Jones be off in another state, and has received compensation with little effort, then there will probably develop a situation in compensation practice that will challenge the best minds in the country to solve. Malingering should be nipped in the bud, and prompt attention to that abuse will save employers and the commissions no end of time, trouble and expense.

*Box 253, Des Moines, Iowa

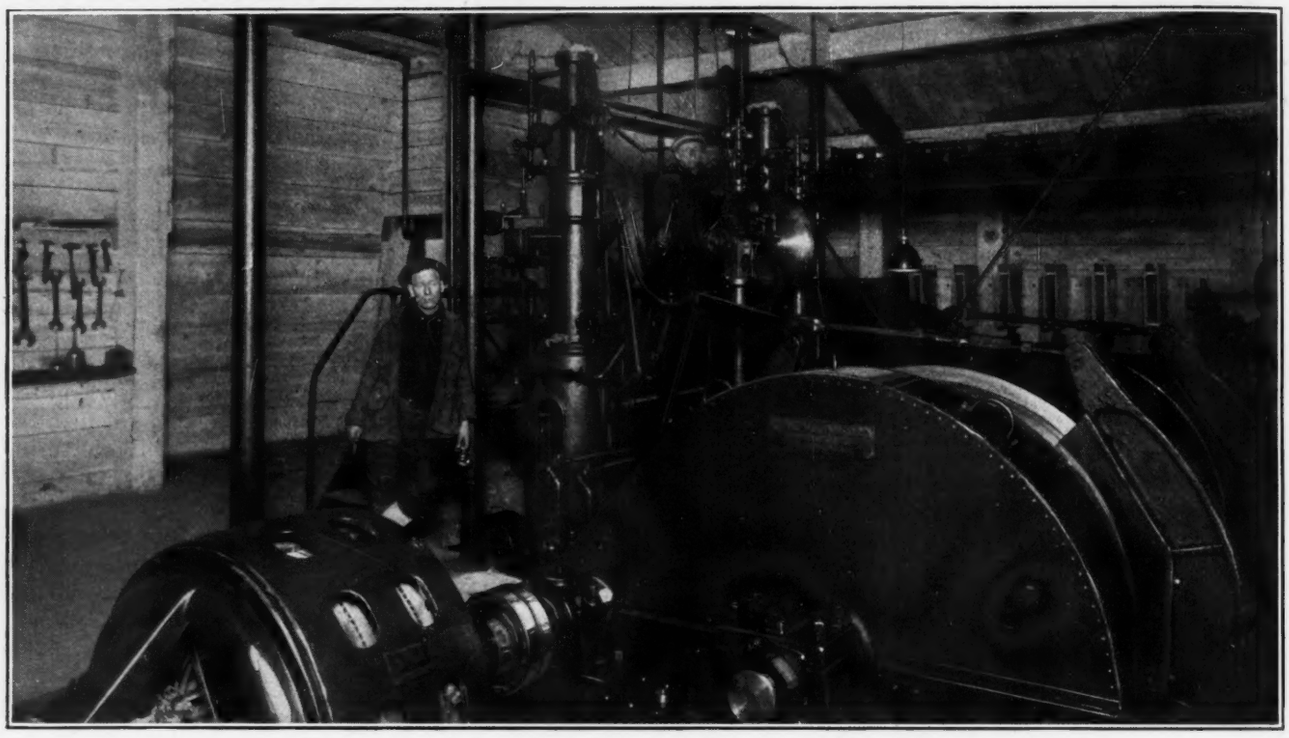
Western Manganese

The probable and possible tonnages of manganese ores in Western mining districts have been estimated by the U. S. Geological Survey and are given in the table that follows:

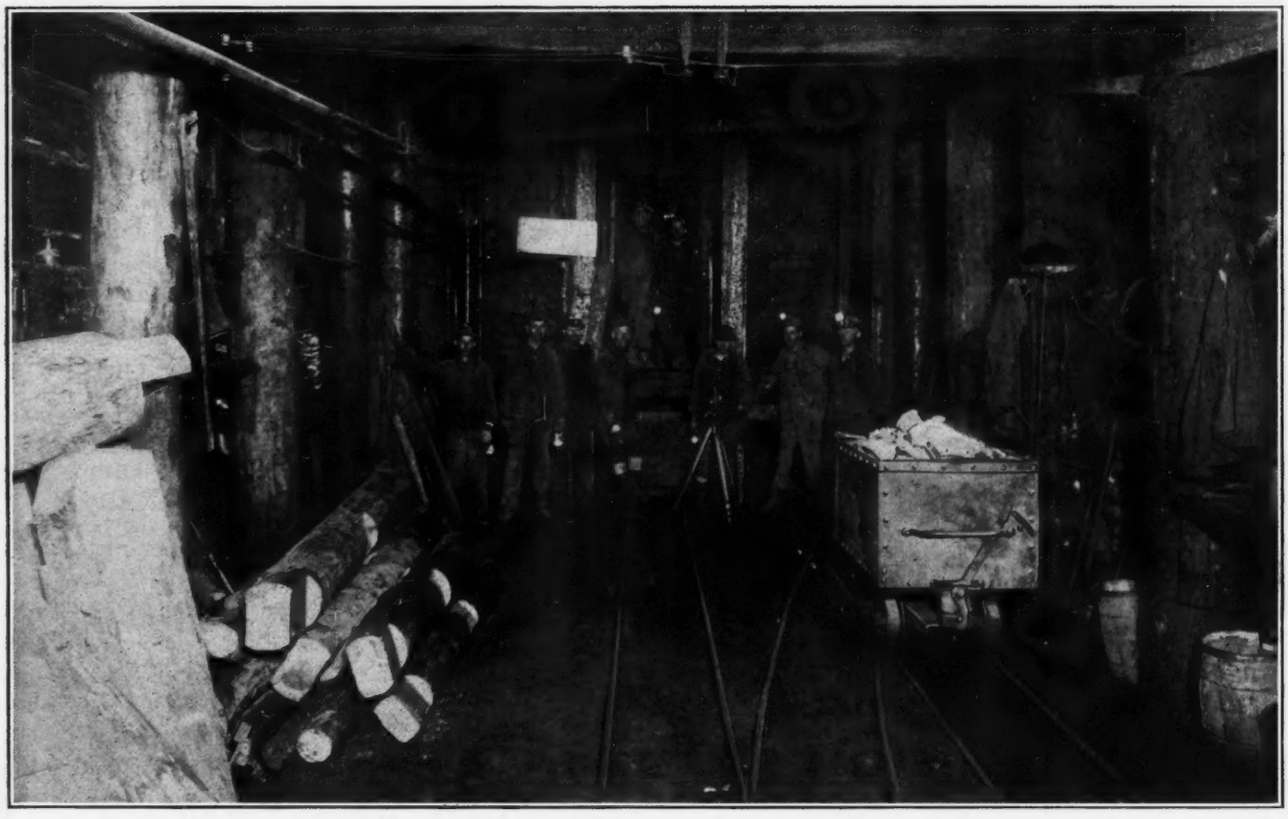
District	Tons Probable	Tons Possible	Number of Deposits in Estimate	Approximate Composition Mn.	Fe.	SiO_2
Philipsburg, Mont...	135,000	350,000	16	37–46	1.5–6	18
Shumla, Tex.....	10,000	100,000	2	15–40	2–5	3–16
Leadville, Colo.....	700,000	1,500,000	13	20–25	24–30	10–15
Silver City, N. Mex.	500,000	1,000,000	2	16	35	6
Red Cliff, Colo.....	750,000	1,000,000	2	14	38	1–2
Pioche, Nev.....	550,000	1,000,000	2	12	34	13

In only a few of the ores from these districts does the phosphorus exceed 0.1%, and many analyses show a content as low as 0.002.

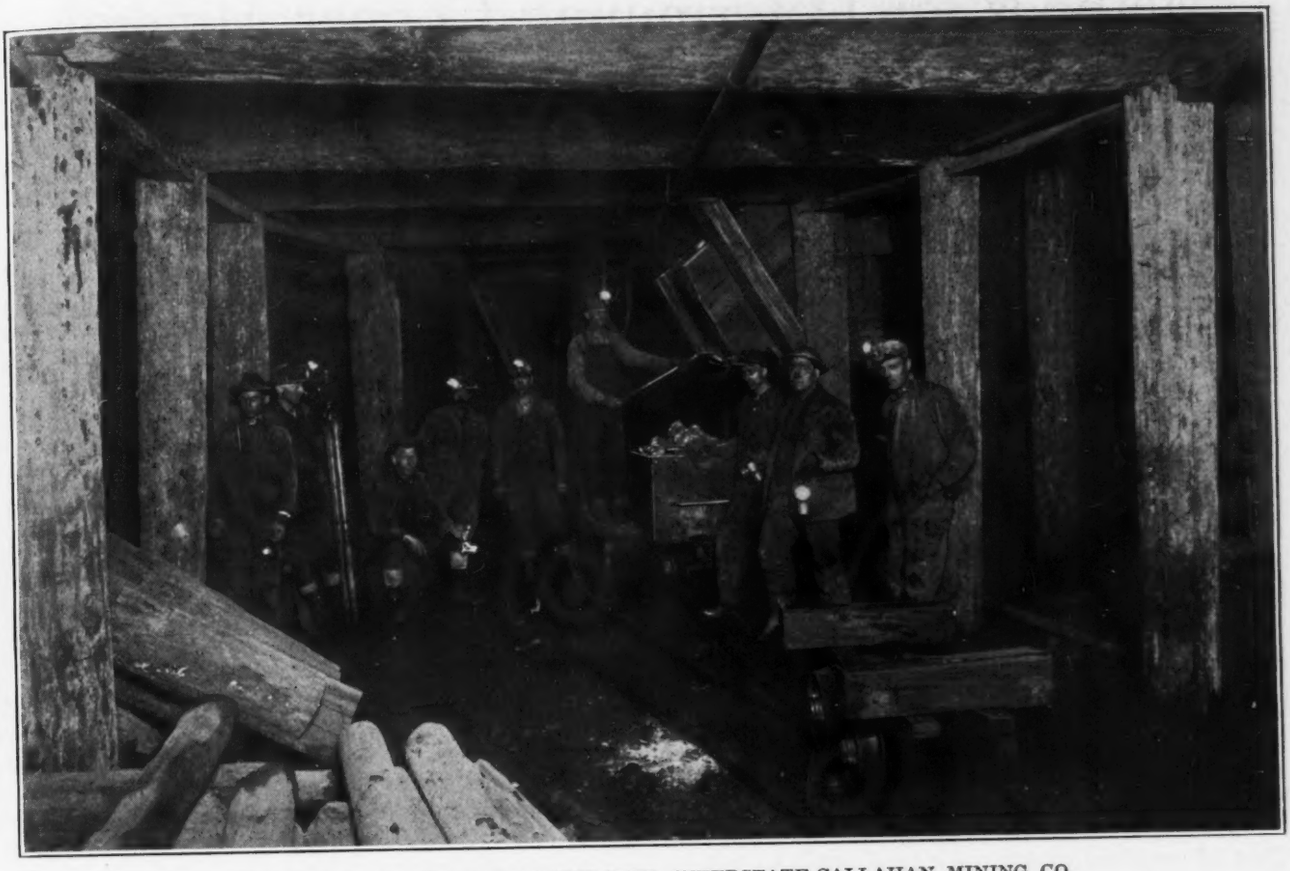
Photographs from the Field



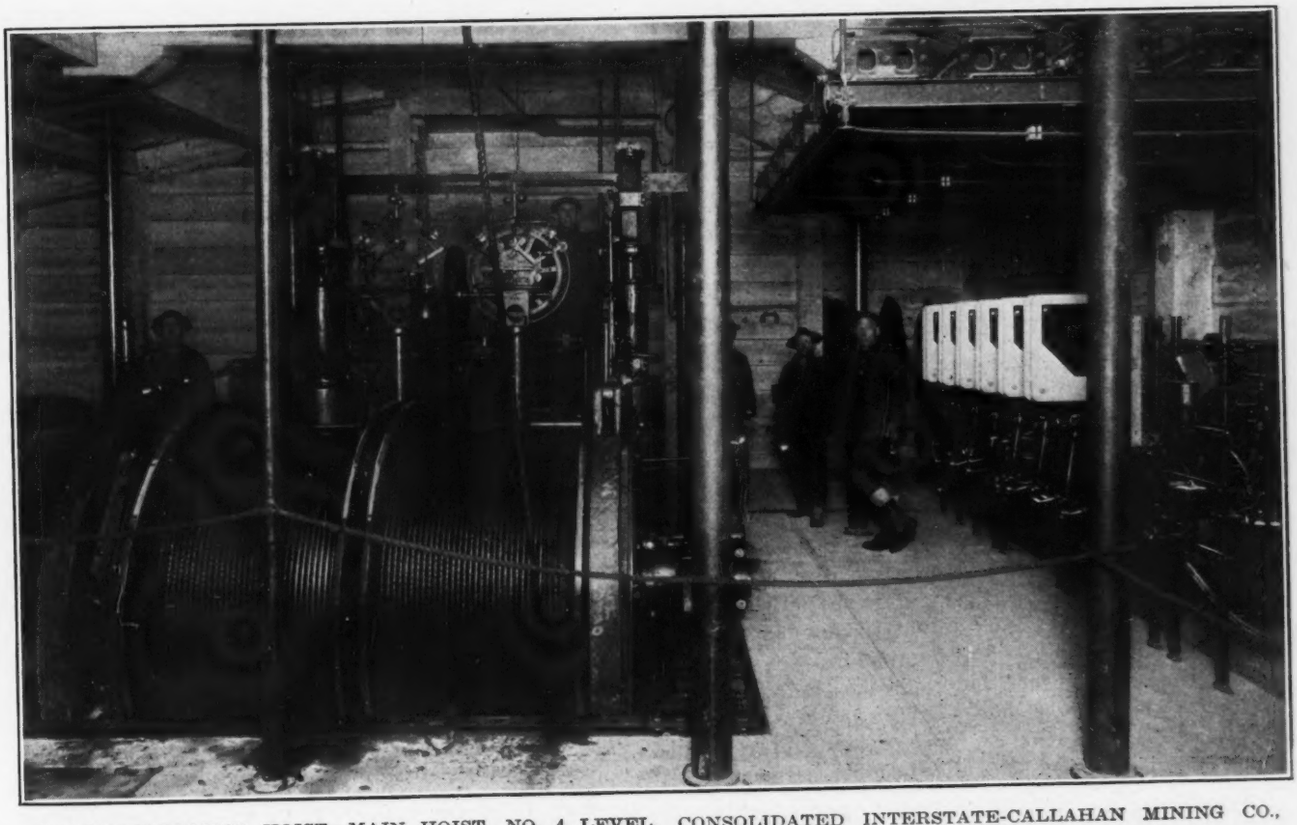
MAIN HOIST, NO. 4 LEVEL, CONSOLIDATED INTERSTATE-CALLAHAN MINING CO.



LEVEL 700; SHAFT STATION, CONSOLIDATED INTERSTATE-CALLAHAN MINING CO.



SILL FLOOR OF STOPE, CONSOLIDATED INTERSTATE-CALLAHAN MINING CO.



AN UNDERGROUND HOIST—MAIN HOIST, NO. 4 LEVEL, CONSOLIDATED INTERSTATE-CALLAHAN MINING CO., WALLACE, IDAHO

Methods for Determining Copper Minerals in Partly Oxidized Ores*

BY CHARLES E. VAN BARNEVELD AND EDMUND S. LEAVER

To distinguish quantitatively between the copper present in an ore in the form of oxidized minerals from the copper combined with sulphur is important to the flotation engineer and the metallurgist. Chemical methods for accomplishing this are described and the results that have been obtained by the different methods compared.

MILLING practice at the porphyry copper mines of the Southwest is in a transition stage because of the rapid changes following the introduction of flotation. Among the several problems that are receiving earnest attention from the operating companies is the recovery of the copper minerals forming the complex ores of the oxidation zone of the deposits.

This problem is under investigation at the Tucson experiment station of the Federal Bureau of Mines. A survey of the status of present laboratory practice brought out the need of a correct and rapid method for the selective determination of the quantity of copper in the sulphide form, on the one hand, and of that in the form of combined oxides, carbonates, silicates, and native or metallic copper, on the other hand, in partly oxidized ores and in mill products from these ores. Such a method is necessary for control determinations on flotation mills treating sulphide ores and also on lixiviation works using either acids or alkalines as the active solvent for the copper in oxidized and silicate form. For convenience in this report such copper is termed "oxidized copper." The methods in common use for selective determination of copper minerals are the sulphuric acid method and the ammonia method. Both are unsatisfactory.

SULPHURIC ACID METHOD

The sulphuric acid method, in which a 5% solution of cold sulphuric acid is used to dissolve all the oxidized copper, is unreliable for several reasons. A certain amount of metallic iron (ranging from 0.1 to 0.5%) is nearly always present in the sample, introduced by the various crushing (mill) and pulverizing (laboratory) processes. This metallic iron precipitates more or less metallic copper from the copper sulphate solution formed by leaching with dilute sulphuric acid, thus giving correspondingly low oxidized copper returns. Another source of error in the same direction is the fact that dilute sulphuric acid dissolves only one-half the copper present as cuprite (Cu_2O). A serious source of error in the opposite direction, making for high oxidized returns, is the fact that chalcopyrite, bornite, and chalcocite are more or less soluble in dilute sulphuric acid (see Table I). Hence, more or less copper in sulphide form is reported as oxidized copper. It sometimes happens that the plus error due to solution of some of the copper in sulphide form is largely compensated by the minus error due to partial solution of cuprite and to deposition of copper on metallic iron. The majority of the ores tested by the writers show high oxidized and low sulphide returns, and check samples show considerable variation.

The results of tests with chalcocite and chalcopyrite, showing the solubility of the copper content in different reagents, are presented in Table I.

TABLE I. RESULTS OF LEACHING CHALCOCITE AND CHALCOPYRITE WITH 5% SOLUTIONS OF DIFFERENT REAGENTS

The mixtures were agitated two hours on a bottle-rolling machine. Five grams of pure mineral were used for each of the mesh sizes indicated

	Proportion of Copper Content Leached From					
	Chalcocite with Solution			Chalcopyrite with Solution		
Mesh	Sulphuric Acid, Per Cent.	Ammonia and Ammonia Carbonate, Per Cent	Sulphur Dioxide.	Sulphuric Acid, Per Cent.	Ammonia and Ammonia Carbonate, Per Cent.	Sulphur Dioxide
20 to 40	0.11	3.87	None	0.03	0.12	None
40 to 65	0.28	7.50	None	0.04	0.18	None
65 to 100	0.36	14.10	None	0.06	0.21	None
100 to 150	0.60	16.60	None	0.15	0.32	None
150 to 200	0.82	17.10	None	0.17	0.45	None
200 to	2.07	22.70	None	0.56	0.93	None

AMMONIA METHOD

The ammonia method, in which a 5% solution of either ammonia or of ammonia and ammonium carbonate is used to dissolve the oxidized copper, is even more unreliable than the sulphuric acid method. The results in Table I show that both chalcopyrite and chalcocite when pulverized are decidedly soluble in solutions of ammonia and ammonium carbonate, the finer the material is ground the greater is the degree of solubility. On the other hand, complete solution of the oxidized copper is rarely attained. This defect is most noticeable in ores having a siliceous gangue and in ores carrying chrysocolla. The solvent gelatinizes the silica, and it appears that the formation of this gelatinous, spongy mass prevents complete decomposition of some of the copper mineral, in addition to holding dissolved copper during filtration.

SODIUM TARTRATE METHOD

While the investigation at the Tucson station was in progress, an improved method was developed by H. D. Hunt and R. V. Thurston, of the research laboratory of the Miami Copper Co. This method was brought to the writers' attention after the completion of their own work on the sulphur dioxide method described in this paper. A description of Hunt and Thurston's, which may be called the sodium tartrate method, was published in the September, 1917, issue of the Colorado School of Mines Magazine.[1] The procedure is essentially as follows:

Place 2 grams of pulp in a beaker, add 20 cc. of a solution of caustic soda-sodium tartrate, and boil the mixture gently 5 to 10 min. with occasional shaking

*Contribution from the Tucson Station, U. S. Bureau of Mines. Printed by permission of the Director.

[1]Hunt, H. D., and Thurston, R. V., The determination of oxidized copper in ores. Colorado School of Mines Mag., Vol. 7, September, 1917, pp. 157-158.

of the beaker. To the hot mixture add 25 cc. of a 20% solution of ammonium sulphate; heat for 10 min. Filter; wash several times with a hot solution of ammonium hydroxide and ammonium sulphate, and finish the washing with hot water. Neutralize the filtrate with sulphuric acid and add 2½ cc. of concentrated nitric acid. It is now ready for electrolysis.

The first treatment with solution of caustic soda and sodium tartrate effects complete and rapid solution of the azurite, malachite, and melaconite, and partial solution of the cuprite. The rest of the cuprite is dissolved later. The chrysocolla also goes into solution. Care must be taken not to boil to dryness or to a small volume. The reagent must be of sufficient strength to redissolve the copper hydroxide first formed by the action of the solution on the oxidized copper minerals in the sample. The ammonium sulphate solution has a two-fold function. It converts the excess sodium hydrate into sodium sulphate and it forms ammonium hydroxide which dissolves any remaining cuprite.

Solutions Required

The following stock solutions are required: Sodium hydrate-sodium tartrate solution, consisting of 100 grams of sodium hydrate and 50 grams of sodium tartrate dissolved in 1000 cc. of distilled water; ammonium sulphate solution, consisting of 250 grams of ammonium sulphate in 1000 cc. of distilled water; and ammonia-ammonium sulphate solution for washing, prepared by adding 100 cc. of ammonium hydroxide and 100 grams of ammonium sulphate to 1000 cc. of distilled water.

Possible Sources of Error

In testing out this method, the writers found that it gives fairly satisfactory results on the low-grade porphyry ores for which it was developed. The method is, however, subject to two well-defined inaccuracies.

One of these arises from the fact that chalcocite is decidedly soluble in ammonia. Washing with hot solution of ammonia and ammonium sulphate unquestionably dissolves more or less copper in the form of chalcocite from the mass on the filter paper. Several tests were made of 2-gram samples containing 3 to 4% of oxidized material and varying proportions of chalcocite. Mixtures containing 8, 16, and 24% copper as chalcocite showed respectively 0.18, 0.33 and 0.45% dissolved in washing and erroneously reported as excess oxidized copper.

Another source of inaccuracy as regards ores containing chrysocolla results from the difficulty of washing all the dissolved copper from the gelatinized spongy mass on the filter paper. Mixtures containing 2½ to 3% copper as chrysocolla showed losses ranging from 0.05 to 0.1%; and mixtures containing 5 and 7½% in this form, respectively, showed losses of 0.33 and 1.42%. These errors tend to balance each other for ores containing both chalcocite and chrysocolla in small amounts. In analyses of ores containing less than 5% copper, the resultant error (see Table II) is not serious.

Sulphur Dioxide Method

The experiments with the sulphur dioxide method were made with the following requirements in mind:

(1) The method must be applicable to a wide range of ores, and must be thoroughly reliable and rapid. (2) Copper sulphides, especially the more easily decomposed chalcocite, must not be affected by the reagent used. 3. Metallic iron must not affect determination.

The method evolved is based on a large number of experiments, the results of which show conclusively that cuprite, melaconite, malachite, azurite, chrysocolla, and metallic copper, when finely pulverized, are readily and completely soluble in sulphur-dioxide solution (sulphurous acid). Copper sulphides are not attacked, no matter how finely pulverized the mineral may be nor how long the time of contact. The two essential features of the method are: (a) fine pulverization in order to completely free the particles of copper minerals from the gangue; (b) the powdered mineral must be kept in suspension by shaking or rolling during the lixiviation or solution period.

The procedure in the sulphur dioxide method is as follows: Place 2 grams of pulp ground to a fineness of 100 to 150 mesh in a bottle, add 100 cc. of a 3% solution of sulphur dioxide. Seal the bottle and agitate by rolling one half to two hours. Filter; wash the residue with sulphur-dioxide solution; add the washings to the filtrate, which will contain in solution all oxides, carbonates, and silicates of copper and all metallic copper. Add 5 to 10 cc. of nitric acid. Boil down to 20 cc. Dilute with distilled water to 150 cc. and determine the copper by the electrolytic method in the usual way.

The residue from filtration contains the unaltered and undissolved copper sulphide. In the experimental work the copper present as sulphide was separately determined in order to check the determination of oxidized copper. Ordinarily this step would not be necessary. In analyses of the low-grade porphyry copper ores of the Southwest, the sulphides may be readily decomposed and all the copper dissolved by proceeding as follows: To the residue add 5 cc. of sulphuric acid and 10 cc. of nitric acid and boil until dense white fumes appear. Add 5 cc. of nitric acid and dilute with distilled water to 150 cc. Determine the copper by the electrolytic method. This method of determining copper in the residue is not suited for heavy sulphide ores containing interfering bases, and for such ores standard methods should be used.

Preparation of Solution

Although sulphur dioxide solution (sulphurous acid) may be readily purchased, it is decidedly unstable; hence the solution should be prepared in the laboratory as needed. Small quantities are easily made by adding moderately strong sulphuric acid to scrap copper tinned on one side; the resulting sulphur dioxide gas is absorbed in water. For continuous work it is better to purchase liquid sulphur dioxide in steel cylinders and drums, which are obtainable in sizes ranging from 6-lb. to 200-lb. capacity. In the first experiments at the Tucson station the sulphur-dioxide gas was introduced directly into the bottle containing the water and pulp. Much loss of gas resulted and the procedure was otherwise unsatisfactory.

Later a simple absorption apparatus was evolved. The absorption tube, 43 inches long, and made of ¾-in. to 1-in. glass tubing filled with broken hard-burned fireclay, is set at an angle of 75 deg. between two glass bottles of 3 to 5 gal. capacity, one bottle being placed about

5 ft. above the other. The tube is open at the top and sealed at the bottom with a plug of sealing wax through which two small glass tubes extend. The upper bottle contains distilled water, which is siphoned into the upper end of the absorption tower, the flow being regulated by a stop cock. A cylinder (capacity 6 to 50 lb.) containing liquid sulphur dioxide is connected to one of the glass tubes extending into the absorption tower. On opening the valve of this cylinder the liquid sulphur dioxide issuing from the valve is gasified by the reduction in pressure and passes into the tower, where it is absorbed by the water from the upper bottle, converted into SO_2 solution of the desired strength and caught in the lower bottle.

This apparatus gives entire satisfaction. With little attention a 3% solution of sulphur dioxide may be produced at the rate of three liters per hour. The cylinder containing liquid sulphur dioxide may be replaced with a gas generator.

Strength of Solution and Time of Contact

Considerable variation as regards strength of solution and time of contact will be necessary in treating different ores from different localities. In general, a solution containing 3% SO_2 should be used. With some ores much weaker solutions, as low as 0.75% SO_2, will do the work. Merely introducing the pulp into the solution, shaking the bottle for a few minutes, and letting it stand, will not dissolve the copper; constant agitation is essential. For a small number of tests a bottle-agitating machine will give satisfactory results. For analytical work where large numbers of samples are run, as in a mine laboratory, a bottle-rolling machine will be found more satisfactory, not only for this purpose but for all solutions requiring constant agitation. The time of contact necessary to completely dissolve the oxidized copper minerals was found to vary from one-half to two hours. Most of the ores and products tested gave complete recovery in half an hour and the most refractory ores invariably yielded in less than two hours.

To determine the strength of the sulphur dioxide solution, the following adaptation of a well-known reaction is recommended; it is based on the fact that introducing either weak or concentrated sulphurous acid into a solution of iodine will result in the complete oxidation of the sulphur dioxide:

Prepare an iodine solution by dissolving 16.8 grams of potassium iodine in distilled water, adding 8.4 grams pure resublimed iodine, and shaking until the iodine is completely dissolved. The more concentrated the potassium iodine solution, the more readily will the iodine dissolve. Bring the solution to proper strength by adding enough distilled water to make a volume of 1 liter and standardize by the thiosulphate method.

The determination is made as follows: To a measured quantity of standard iodine solution add slowly with constant stirring the proper volume of sulphur dioxide solution. So regulate the volume of iodine solution used that the mixture always contains a decided excess of iodine over the quantity required to oxidize the sulphur dioxide being added. An excess of sulphur dioxide causes the solution to clear and to lose its dark-red color. If an excess of sulphur dioxide is added the determination is spoiled, and the test should be repeated with fresh sulphur dioxide solution and larger quantity of iodine solution. Thus, there is a direct ratio between the strength and quantity of sulphur dioxide solution and the quantity of standard iodine solution. In general, for solutions containing 1 to 3% sulphur dioxide 1 cc., and for weaker solutions 20 cc. of standard iodine solution should be used. The mixture is then titrated by the thiosulphate method to determine the quantity of iodine remaining in it. The difference between this quantity and the total quantity of iodine represents the iodine used in oxidizing the sulphur dioxide. The strenth of the sulphur dixoide solution may then be calculated according to the formula:

$$SO_2 + H_2O + 2I = 2HI + SO_3$$

Comparison with Other Me hods

Comparative results obtained with the four methods described on ores and mill products from the Morenci,

TABLE II. RESULTS WITH THE FOUR METHODS COMPARED

Source of Sample	Copper Content Per Cent.	Oxidized Copper (Oxide, Carbonate and Silicate) By Sulphur Dioxide Method, Per Cent.	By Sodium Tartrate Method, Per Cent.	By Sulphuric Acid Method, Per Cent.	By Ammonia Method, Per Cent.
Inspiration mill feed	1.31	0.35	0.33	0.41	0.36
Inspiration mill slimes	0.43	0.32	0.28	0.35	0.07
Miami complex ore	2.24	1.05	1.02	1.32	0.91
Morenci mill sands	0.64	0.09	0.07	0.23	0.09
Morenci mill slimes	0.52	0.20	0.18	0.26	0.04
Ray mill sands	0.47	0.04	0.03	0.18	0.12
Ray mill slimes	0.52	0.27	0.25	0.32	0.22
Chino mill heading	1.18	0.19	0.19	0.52	0.24
Chino mill tailing	0.45	0.13	0.15	0.31	0.02
Chino mine ore	2.49	0.95	0.94	1.18	1.12
New Cornelia (Ajo) ore	1.26	0.42	0.42	0.76	0.22
Ruth mill heading	1.65	0.25	0.29	0.41	0.49
Giroux mill tailing	0.58	0.01	0.02	0.08	0.04
Nevada Con. mill heading	0.82	0.07	0.05	0.30	0.25
Nevada Con. mill tailing	0.33	0.02	0.03	0.08	0.04
Utah copper mine ore	2.53	0.24	0.26	0.57	0.50
Utah copper mill feed	0.89	0.60	0.56	0.63	0.37
Utah copper mill tailing	0.63	0.07	0.06	0.11	0.09
Miami ore (special test):					
20 mesh	2.25	1.06	0.96	1.18	0.83 to 0.90
48 mesh	2.25	1.05	0.98	1.28	0.62 to 0.98
65 mesh	2.25	1.06	1.00	1.30	0.95 to 1.10
100 mesh	2.25	1.06	0.97	1.32	0.91 to 1.10
150 mesh	2.25	1.07	0.92	1.32	0.92 to 1.06
200 mesh	2.25	1.06	1.02	1.34	0.88 to 1.09

Note.—In the sulphur dioxide method any metallic copper present would be reported as oxidized copper. In the other three methods, metallic copper would be reported as sulphide.

Globe, Ray, and Ajo districts in Arizona, from Chino, from Bingham, Utah, and from Ely, Nev., are presented in Table II. The table shows that, compared with the sulphur dioxide method, the results for oxidized copper are high with the sulphuric acid method and low with the ammonia method. The sodium-tartrate method shows uniformly and slightly lower returns. The last sample in the table, designated "Miami ore, special test," was crushed to 20-mesh size, special care being taken to prevent overcrushing. Five portions were then taken and crushed with the same care to the successive sizes listed. The uniform results for oxidized copper by the sulphur dixoide method are evident. The results with the sodium-tartrate method, which was developed on this class of ore, show more variations and are slightly lower. The sulphuric acid method shows high returns, which are progressively higher for the finer sizes. Results with the ammonia method are low and show considerable variation.

Conclusions

Sufficient work has been done with the sulphur dioxide method to substantiate the following claims:

1. Cuprite, melaconite, malachite, azurite, chrysocolla, and metallic copper are dissolved rapidly and completely.

2. Chalcocite and chalcopyrite are not affected.

3. Metallic iron in ordinary quantities, even up to 3%, dissolves rapidly and has no effect on the determination, provided there is a strong excess of SO_2.

4. There is no gelatinization of silica, and the possible loss of copper from this cause, noted in analyses by the other methods described, is eliminated.

5. The method is applicable alike to high-grade and low-grade ores. The manipulation is simple and the possible sources of error are few. One chemist can keep a 6-unit electrolytic outfit working to full capacity on porphyry ores.

6. Any metallic copper present would be reported with the oxidized copper. If a separate determination of metallic copper is considered necessary, this may be made by amalgamation, the operation being preferably in an amalgamated copper pan.

7. Crushing fine enough to liberate completely the mineral particles is essential. Ores containing an appreciable proportion of chrysocolla should always be pulverized to 150 mesh.

War-Baby Mines

By F. F. SHARPLESS*

For several months a new group of prospects and mines have been coming to town, war-baby mines they might appropriately be called, pyrite, manganese, molybdenum and reborn silver mines. The advice given to vendors of mines by the *Journal* on former occasions might be repeated with advantage to a large number of gentlemen, now occupying rooms at our hotels, who spend the day passing from office to office and the evening in looking up metal quotations and wondering why their propositions are being turned down without investigation and why 10-oz. silver ores are not attractive with silver at 80 cents.

It is the same old story, inadequate mine reports or no reports at all, with expectations based upon present metal prices and past production costs. That the *Journal's* quotations are real, not fictitious, is true; the metals are needed and are bringing high prices, but for many reasons capital is more wary than ever, demanding positive information as to what is offered and a very wide margin of safety for investment. If vendors would only spend a few hundred dollars in securing intelligent reports upon their properties, there would be less occasion for long sojourns at the hotels, and fewer offices would be visited before interest in the business was shown. Such reports would not only tell the possible purchaser what was offered, but they would show the vendor what profits might be expected under existing conditions and would prevent him from suggesting inordinate terms. They would also prepare his mind for reasonable business if business were at all possible.

It is human to regard a 10-oz. silver ore of greater value today than it was in 1914, but analysis of production costs shows the increased value of the metal to be more apparent than real, and that the margin of profit has not grown as rapidly as the selling price. This is not equally true in the case of metals which have heretofore come largely from abroad, and yet production costs are an important factor also in the value of these metals. So far as my experience goes, lack of interest in these new offerings is mainly due to lack of information on the part of the vendor, and that such vendors are doing comparatively little business after they have secured attention is due to their demands, their inflated ideas respecting their holdings and their expectation of finding a large amount of capital ready to finance war-metal properties.

Just how far official sanction will go toward permitting the financing of large metal-mining operations is at present uncertain. It is very certain, however, that unless the metal sought is one essential to war activities, heavy financing will be frowned upon. Again, there are many organizations and individuals with considerable surplus capital who are not now in a position to be absolutely sure that more or less of this surplus may not be absorbed in taxes, or, even knowing what must be paid in taxes, they will hesitate to put into commercial use what might be invested in Liberty Bonds. If, however, the vendor, having faith in what he has to offer, seeks only aid for placing his metal on the market, is willing to take his profit from the property in question, and does not ask for it in anticipation of its being realized, there is an excellent chance of securing the relatively smaller amount of capital that he absolutely requires.

Several of the manganese properties that have recently been brought to the writer's attention might now have been adding their small quota of that metal to the general supply had the owners been willing to accept the funds actually needed for development and equipment, taking their chances with new associates, rather than trying to capitalize future production. The same is true of several pyritic deposits, requiring only a small amount of money for prospecting and to start them going in a modest way.

There was recently offered in New York an old silver mine, or, rather, a group of old mines, respecting which it was represented that many thousand ounces were contained in dumps, fills and tailings that could, at 85c. silver, be recovered at a handsome profit. The party holding the option on the group proposed to form a $2,000,000 corporation and to raise $500,000 cash capital for immediate purchase and equipment. Investigation showed that, so far as financial arrangements were concerned, the business could be satisfactorily handled with $100,000, provided, of course, that the silver was present as claimed, reducing the risk to practically one-fifth the amount the promoter called for, making it a business that could easily have been handled by one or two individuals, and altering it from a questionable undertaking to one with practical and possible features. This is simply given as an example of the reason why war-baby mines are failing to get proper nourishment and failing to develop into husky youngsters.

A summary of my advice to the vendors of such properties is: secure an intelligent report upon your property, a report that you can guarantee as substantially correct as to facts, and limit your search for funds to an amount absolutely necessary to put the property into the producing class. Your chances for success will then be excellent.

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Report of Mount Lyell Mining and Railway Company, Ltd.

At the annual meeting on Dec. 14, 1917, it was reported that the only serious interruption to the work during the year was the miners' strike that occurred in May. As a result of the strike the hours of work for underground men were reduced from 48 to 44 per week. This and labor shortage reduced the annual output from 334,890 to 260,379 tons. Ore reserves are estimated at 2,013,439 dry tons, averaging 0.5% copper, 1.6 oz. silver and 0.04 oz. gold per ton for the Mount Lyell mine, and 997,904 dry tons, averaging 6% copper, 1.33 oz. silver and 0.005 oz. gold per ton for the North Mount Lyell mine. The output of blister copper was 5832 tons, a decline of 744 tons for the year. Only two furnaces were operated. The cost per ton of ore shows a considerable increase: $6.42 per ton for the year ending Sept. 30, 1917, as compared with $4.56 per ton for the year ending Mar. 31, 1916. The net profit from all sources amounted to $1,275,902 for the year. The flotation plant, operated on day shifts, treated 14,128 tons of ore, averaging 2.91% copper, and produced 3902 tons of concentrates, assaying 9.31% copper, 0.61 oz. silver and 0.06 oz. gold. The recoveries for the year were 88.52% copper, 75.12% silver and 71.88% gold.

A new converter plant was made ready for operation. Lyell Comstock ore and flotation concentrates have been tested by a leaching process at the Edwards Pyrites Works, Ballarat. From five charges, an average recovery of 78% of the copper was obtained. Experimental work for the recovery of sulphur from pyrite was continued. The Lake Margaret hydro-electric power plant was in continuous operation and an electrically operated compressor was completed.

Quarterly Report of Ray Consolidated

Ray copper production in concentrates for the quarter ending with 1917 was 21,071,874 lb., as compared with 21,654,342 lb. of the previous quarter. From ores sent directly to the smelter there was produced 1,678,803 lb. of copper, making a total production of 22,750,677 lb., as compared with 22,972,156 lb. for the previous quarter.

During the quarter there was milled 893,800 dry tons, averaging 1.6% copper. This tonnage corresponds to a daily average of 9715 tons, as compared with 9797 tons for the previous quarter. The mill extraction for the quarter was 73.74% of the total copper contained in concentrating ores, as compared with 73.75% for the previous quarter. The underground development for the quarter was 15,454 ft., making the total development to date 640,009 ft. The milling cost for the quarter was 91.042c. per ton, as compared with 88.46c. for the previous quarter. The average mining cost of ore milled for the quarter was $1.29 per ton, of which 5.10c. was the cost of coarse crushing, leaving the net mining cost $1.24 per ton, as compared with a net cost of $1.11 for the previous quarter.

The total amount set aside for the county, state and Federal taxes during the quarter was $239,786. This tax reserve has been created on the same basis used in the three previous quarters. It will doubtless be subject to revision when the new Federal tax laws have been further interpreted as referring to mining companies. This revision of this reserve will be shown in the annual report. The average cost per pound of all net copper produced for the quarter was 13.836c. This compares with a cost of 12.795c. for the previous quarter, and included a charge of 12½c. per ton of ore milled for the retirement of mine development expenses and credit to operating costs of dividends from the Ray & Gila Valley R.R., gold and silver produced and all other miscellaneous income. The average carrying price of copper for the quarter was 25.593c., as compared with 15.906c. per lb. for the previous quarter. The difference between the carrying price shown and the Government-fixed price at which sales were actually made during the quarter is accounted for by the fact that unsold stock of copper carried forward from the preceding quarter at 13½c. was reduced. Net operating profits and miscellanous income totaled $2,570,872, disbursements to stockholders, $1,577,179, and surplus, $993,693 for the quarter.

Quarterly Report of Chino Copper

Chino's copper production for the quarter ended Dec. 31, 1917, was 20,266,715 lb. The total amount of ore treated for the three months was 934,000 tons, being an average of 10,152 tons per day. This is 348 tons less per day than for the third quarter. The average copper content of the ore treated in the mill during the fourth quarter was 1.64% copper, as against 1.61% copper for the third quarter, 1.70% copper for the second quarter, and 1.60% for the first quarter of 1917. The recovery per ton of ore milled for the last quarter of 1917 was 21.7 lb. gross, as against 22.66 lb. gross for the third quarter, 23.99 lb. gross for the second quarter and 22.58 lb. gross for the first quarter of 1917. There were produced 61,642 dry tons of concentrates averaging 16.44% copper, as against 75,121 dry tons of concentrates averaging 14.57% copper for the third quarter of 1917.

The cost per pound of net copper produced for the fourth quarter, after allowing for smelter deductions and crediting all miscellaneous income, was 13.65c., as against 12.14c. for the third quarter, 9.65c. for the second quarter, and 10.12c. for the first quarter of 1917.

The net profit and miscellaneous income totaled $2,282,167; dividend disbursement, $1,739,960 and surplus, $542,207 for the quarter. The earnings for the last quarter of 1917 are based on 25.43c. per pound for copper, as against 17.14c. per pound for the third quarter. This difference in price was due almost wholly to variation in the quantity of unsold copper inventories at 13½c. at the end of the respective quarters. During the fourth quarter there was removed by the steam shovels at Santa Rita a total of 1,342,193 cu.yd. of material, or an average of 447,398 cu.yd. per month, as against a total of 1,372,741 cu.yd. of material, or an average of 457,580 cu.yd. per month, for the third quarter of 1917. Of the total material removed for the fourth quarter, 858,653 cu.yd. were stripping, the remainder being equivalent to 933,491 tons of ore, of an average grade of 1.612% copper, according to mine samples and assaying.

Correspondence and Discussion

The Wages Problem

In the *Journal* of Jan. 5 I notice discussion of the article by Justus F. Mozart on "The Wages Problem." Here in Mexico, during the time of variable-value paper money, we have had to deal actively with the problem of "What constitutes wages." Mr. Mozart states that the workman must, or should, receive his normal supply of food, shelter, and clothing that go to make up his daily needs. And if the cost of these things varies and becomes too much to be within the limits or reach of the wages, there must be some readjustment, so that both ends may meet. It then becomes a matter of vital interest to decide what latitude and what limit should be allowed the daily needs of life.

During a long period of normal times the workman undoubtedly accommodates his ideas of his daily needs to the normal wages that he is receiving. The $2 a-day man lives within his $2, and the $6 a-day man within his $6. Times change, industry has a boom, the $2 man gets $4 wages, and the $6 man gets $10. Both of them spend all their wages and accommodate their daily needs to the new wages. The merchant puts up his prices accordingly, so as to absorb the increased money from higher wages. Times change again and return to normal conditions. Wages must come down again, but $2 and $6 do not suffice to cover the daily needs, according to the ideas acquired during the time of high wages.

The facts regarding the employers' ideas must also be noted: In normal times he was pleased with the moderate profit that he was obtaining during the $2 and $6 wage period; during the boom he obtained twice his customary profits. When times go back to normal he is no more satisfied with his former rate of profit than is his employee with his $2 wage. He tries to secure a rate of profit that is not compatible with the condition of the times.

The employer is one, and the workmen are many, so more voices are heard, and the general public inclines to take the view that the workmen are unreasonable. No doubt the average workman is illogical and unreasonable in his views; few workmen have any conception of what proportion or part of the costs of production is formed by the wages paid. They usually consider their own wages as the one important item of the costs; so when selling prices are high their wages should be high; but when selling prices go down they are not broad-minded enough to admit that their wages also should go down. The laboring man must bring himself to take more rational views on these matters, and the employer also must do the same respecting his profits. Until public opinion forces both to change their attitude, the conflicts between the two parties in interest must continue.

In the States, politics has a lot to do with the arranging of wages; one cannot say "adjusting," because to adjust means to bring into proper relation. So wages are arranged, not adjusted. Here in Mexico, wages used to be adjusted, and have been during the revolutionary period. As the revolution was a laboring man's affair, we shall likely have more political influence exerted on the wages problem than we used to have; but during the turbulent times wages were really "adjusted." That is, it was recognized that if work were to go on, the workman must have his daily needs in the way of sustenance, regardless of the conditions of money circulation or of commercial affairs.

The Mexican peso is not of stable value. When paper money began to circulate the authorities decreed and enforced that "pesos is pesos," when speaking of terms, and a peso in paper money was to be accepted and to do business just as the silver or gold peso used to do. Silver debts could be paid with paper money, etc. In a short time the paper peso would not buy the merchandise that a silver peso used to, and after a while it became so that it took fifteen, twenty, forty paper pesos to purchase what was once bought with a silver peso.

Naturally, the employer wished to maintain the wages paid, at as near a normal rating as he could, in terms of real money-silver, so that when the revolution should be over and normal times return, his business conditions would also be normal. The average day's pay of a peso and a half, in silver, in normal times, was ample to cover the daily needs of the workman and his family, but in paper money the equivalent sustenence cost twenty to forty pesos, so that it was manifestly impossible to pay him a peso and a half in paper money. There was no silver or gold money available—the paper money was all that was to be had. Nor was it feasible to calculate the wages on silver basis, multiply by the rate of exchange for the day, and pay the resulting amount in paper money. There would have been never-ending arguments and conflicts over what rate was fair to be used that day. The average workman is not intelligent enough to comprehend the necessity of the day's pay varying daily; those intelligent enough are not sufficiently broad-minded to accept such conditions and to return to normal ratings of pay when conditions become normal.

There was little or nothing of constitutional authority; just a changing lot of military rulers, most of them putting out arbitrary decrees imposing conditions of prices and wages. But in fact employer and employee were left to their own devices. Each recognized the abnormal conditions and that each must make some concessions for mutual benefit. But it was a clear-cut case of where the employer recognized the theorem that if business were to continue, the employee, according to his category, must receive his due wages, which would be enough to cover his daily needs.

How the adjustment was made was a variable matter, and often arbitrary. The common way was that the employer went out into the market and bought the things necessary for the workman's daily needs, issued

them to him at normal prices, and paid him wages of normal times; all in paper money and with paper money. The result was more bookkeeping in order to apportion the consequent store deficit to the work going on. That deficit was more apparent than real, as the work going on should cost a certain amount in silver or gold money. The employer turned over that much gold money to his storekeeper, who went out and bought paper money with it, and with the paper money bought merchandise and sold it to the workmen at prices of normal times against normal-times wages. I do not say that throughout Mexico, and under all conditions, this perfect adjustment was secured, but it was aimed at, and was approached as near as could be under the strenuous circumstances and conditions of the country. In my way of thinking it constituted paying the workman the wages due him, and in practice recognized the principle that it is right and is necessary that the workman receive enough to cover his daily needs.

All this with reference to the day-pay man. But there were many instances wherein employers were forced to adjust monthly salaries to conditions. Their enterprises being stopped, or working on reduced scale, salaries had to come down or be cut off. In many cases the employer said to his salaried employee, "Our business does not permit our continuing present expenses. I must adjust my expenses to the conditions existing. If you wish to continue with me, doing your present work as it is or may be during these times, and will forget all about your salary, I will pay you a fair amount, equal to your living expenses, and we shall continue this arrangement while present conditions exist. When conditions become normal we shall return to normal salaries." Such a proposition also constitutes paying wages or salaries due, or rather, recognizes that the employee must have his daily needs covered if business is to go on.

It might be possible to have a wage and bonus system established, wages to be those paid in dull times. No bonus in dull times, but, with increase in business, a corresponding increase in wages, establishing the factor with which to calculate the bonus. The bonus might vary as times should vary, but the wages would always remain the same. The workman can reconcile himself to a changing bonus, but it is against his religion to lower his wages. X.

Mexico, Jan. 16, 1918.

Metallurgy of Zinc

I note in the article the "Metallurgy of Zinc," appearing in the *Engineering and Mining Journal* of Jan. 12, the following paragraph:

"The old, wasteful Zellweger furnace is passing out of use. During 1917 three furnaces of this type of the Bartlesville Zinc Co. were changed into an adaptation of the Ropp furnace. The results have been gratifying, inasmuch as gas consumption has been reduced to less than one-half the former figure, and the roasting capacity has been slightly increased."

I wish to call your attention to the fact that credit for this improvement is due the American Zinc, Lead and Smelting Co. That company changed at the Caney plant two of the Zellweger furnaces to a modified Ropp according to my design, in the latter part of 1912, and during 1913 had five furnaces of this type in operation at Caney and Dearing; the results being as stated in the article referred to, that the gas comsumption was reduced to less than half and the roasting capacity slightly increased. I personally know that the Caney furnaces were ahead of any others, those referred to in your article having followed closely the pioneer work done at Caney. C. ALBERT WETTENGEL.

St. Louis, Mo., Jan. 24, 1918.

Fine-Grinding and Porous-Briquetting of the Zinc Charge

The article in the *Journal* of Feb. 23, from the paper by Woolsey McA. Johnson read before the American Institute of Mining Engineers, is interesting, and is perhaps the first public notice of progress in the line of fine-grinding of zinc-retort charges and contact relations of mass. Creditable as the results are, they only partially approach results obtained by me at one of the largest middle-west smelteries over two years ago, where we briquetted tons of the more difficult flotation slimes pulverized to over 100 mesh, and operated with the raw ores and all degrees of roasted ores with residues that for weeks assayed about 1% zinc. The raw ores required a sulphur fixation agent. The briquetting was radically different from that described by Mr. Johnson, and the retort charges ran up to about 125 lb. per charge, as I recall, for roasted ore, with 105 lb. for unroasted ore carrying the sulphur fixing agent. The reducing carbon of the charge amounted to from 15 to 20% of the mass. The retorts used were the usual size holding less than 100 lb. of the loose mix where 45% of admixed carbon was adequate.

Little interest was taken in the work at the time, which surprised me, and I was advised that while the results were interesting real commercial advance was questioned, and the company on mature advice of its experts made no move to adopt the results or equip a plant unit. The figures of Mr. Johnson are attractive, and, made in connection with 75% or more carbon reducing mix, show vividly. Why zinc smelters don't briquet even to the degree Mr. Johnson prescribes, and much better if they desire, is a conundrum to me, and why they permit slagging of retorts and residues above 1% in zinc is merely an illustration of technical pique and corporation sluggishness. I am not at liberty to further publish private data without permission, or I would aid the general cause; but it may be noted in passing that proper briquetting so increases the heat conductivity of the charge that the time of distillation is reduced about 33% for a given sized retort as against loose charging; and, furthermore, the temperature of the furnace can be at least 100° C. less. This directly effects a saving in the fuel used in distillation which amounts to fully 33%, and it enables a retort of perhaps 12 in. in diameter to be used for a 23-hr. distillation time. PARKER C. CHOATE.

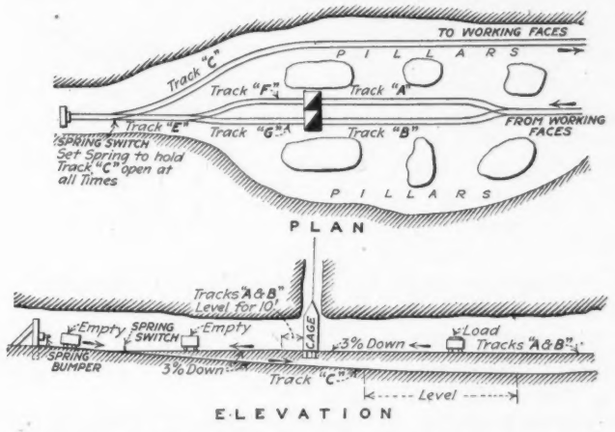
Essex, Mass., Feb. 27, 1918.

Remember the Comfort Fund of the 27th Engineers.

Details of Practical Mining

Simplified Caging with Heavy Mine Cars

In the Southeast Missouri lead district the prospect of labor shortage has been responsible for the introduction of a number of labor-saving devices. One of the companies operating in the district has reduced the amount of labor required underground for caging cars from four to two men per shift. All the ore is hoisted in cars by cages from one main level in a two-compartment shaft. As shown in the accompanying sketch there is a heavy down grade toward the shaft favorable to the load. The cars are of the solid-box type, with bumpers at each end, have a capacity of 22 cu.ft. and are provided with roller bearings.



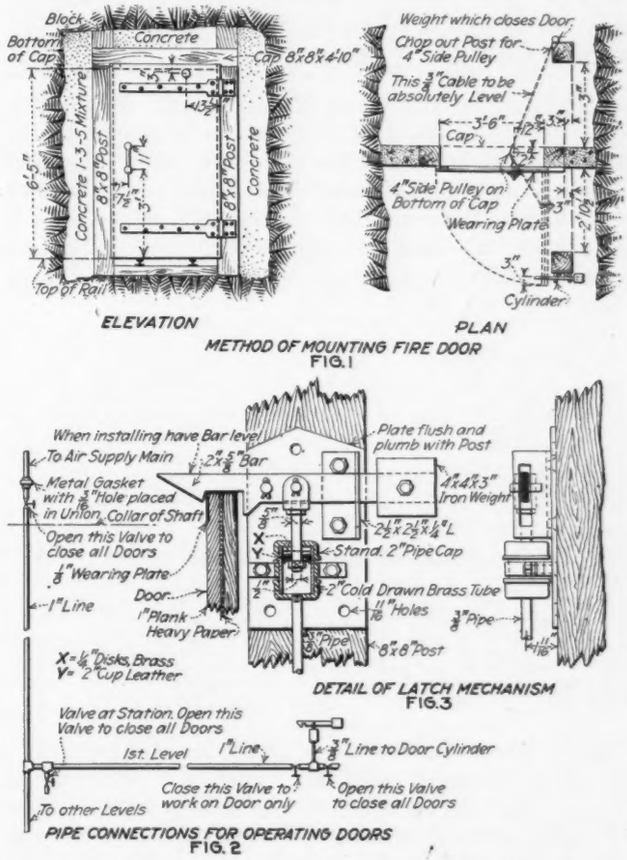
STATION ARRANGEMENT FOR SIMPLIFIED CAGING

The cages are especially equipped to hold the cars without hooks or gates. This is accomplished by means of a "drop-track" arrangement on the cage deck. An internal section of the deck track drops about an inch when the cage is released from the chairs, thereby forming a depression between each end of the deck track which prevents the car from moving. When the cage rests on the chairs the dropped track is raised, forming a continuous track along the cage deck over which the car will travel.

When an empty car is landed at the shaft station the chairs raise the car, which is then free to be moved off. A loaded car is run down grade toward the empty by the cagers, who hold it back to a speed just sufficient to bump the empty off the cage and run on the loaded car in its place. The loaded car is steadied by the cagers, who give the signal to hoist and release their hold as soon as the chairs release the drop-track. The empty meanwhile passes from the cage on a downward grade toward the open spring switch of a return track. The return track has an adverse gradient and a course around one side of the shaft cut below the general level. As soon as the empty car passes over the frog of the return switch, it strikes the adverse grade, and a short distance beyond the car meets a spring bumper which arrests its progress and gives it a slight impulse in the opposite direction down grade on the return track, by the switch and around the shaft to a level gathering track where the empty cars await to be coupled into trains and hauled back to the main haulage level by an electric motor.

Air-Controlled Fire-Door at Copper Queen Mine

A device for closing fire-doors simultaneously all over a mine by opening an air valve anywhere on the system from the surface to the stopes is described by Gerald Sherman[1] in a paper[2] read before the meeting of the American Institute of Mining Engineers in February, 1918.



DETAILS OF FIRE DOOR AT COPPER QUEEN

A sketch of the doors is given in Fig. 1, and a diagram of the piping system through which they are operated is shown in Fig. 2. Fig. 3 gives details of the operating mechanism. The doors are set in concrete,

[1]Superintendent of Mining Dept., Copper Queen Consolidated Mining Co., Bisbee, Ariz.

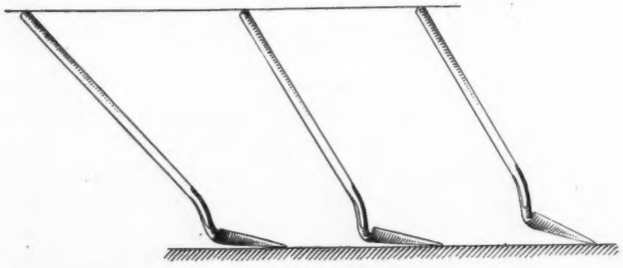
[2]"Measures for Controlling Fires at the Copper Queen Mines," Bull. 133, Am. Inst. Min. Engr.

and are normally held open by a latch: when the latch is raised, the door is closed by a weight. The latch is held locked by an air cylinder acting against a counterweight. The air cylinders connect by piping, with all doors protecting the shaft and with the compressed-air main on the surface. By opening a valve at any station, or at the surface, the air system is drained of air, the pressure on the cylinder falls, and the weight throws the latch and allows the doors to close. Any door, of course, may be opened by hand afterward. A small hole in a metal gasket furnishes enough air to supply leakage in the pipe system but not enough to prevent the fall in pressure when any valve is opened. By this arrangement, if anything goes wrong with the piping or air pressure, the doors close automatically; if the latches were thrown by cylinder pressure, instead of the reverse, they would fail in case of accident to the air line or its injury by the heat of a fire not quickly discovered. It is probable that the doors cannot be made air-tight, but if necessary they can be easily and quickly caulked by helmet men, after they are closed.

The Regular Long-Handled Shovel

BY H. M. WIRTZ*

The regular long-handled square and round-point shovels, when used with full length of handle in the proper position, possess the correct lift and hang, but probably 95% of the handles of regular long-handled shovels used underground in most metal mines are cut off from 5 to 8 inches. This shortening of the handle automatically places the shovelers closer to the blade,



CORRECT AND INCORRECT BLADE TO FLOOR ANGLES FOR LONG- AND SHORT-HANDLED SHOVELS

The shovels on each end of the illustration represent the angles obtained by the standard design before and after shortening the handle. The shovel at the center illustrates the proper angle for the shorter handle.

thereby increasing the angle of the shovel handle and tilting the blade at the point. Such a position of the shovel gives it a tendency to dig downward, as shown in the illustration, making it harder to load, and when mucking off the rough is fatiguing and exasperating; even when shoveling off a board floor the point of the blade will meet irregularities, causing shocks.

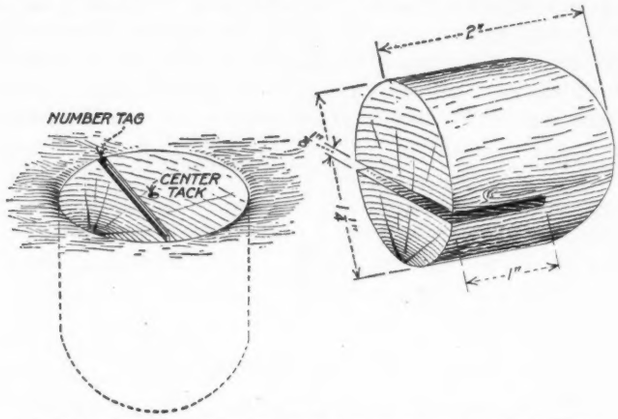
A long-handled No. 2 or No. 3 shovel with handle 6 in. shorter than the regular, with a proportionately lower lift of the blade, would not only be popular, but also would increase the efficiency of the shoveler. One would unconsciously do more and better work with less expenditure of energy. From considerable actual experience and observation with various types of shovels I am firmly of the opinion that the adoption of such a shovel for all-around underground purposes would result relatively in the highest efficiency.

*Bisbee, Arizona

Marking Mine Survey Stations

There are various methods of marking underground survey stations for future reference, namely, with tags tacked directly to the wooden plug, or suspended by a wire or string; numbering or lettering the face of the plug with paint or lamp marks and other well known methods. The following method has, however, been found to give satisfaction.

Since the survey stations or survey plugs are usually sawed to approximately the required length and trimmed before placing in the hole, it is a simple matter to make a single extra saw cut to receive a small metal tag previously numbered.



DETAILS OF SLOTTED PLUG WITH TAG INSERTED

The plug is first trimmed and prepared for fitting into its hole in the roof or floor of the mine, then the tag is placed in its slot and the plug firmly driven home. The wood will draw together or shrink enough to close the slot and prevent the tag from falling out if the plug is in the roof.

The metal tag may be easily withdrawn by the aid of a knife or other sharp pointed instrument when identification becomes necessary and replaced when it has served its purpose.

Triangulation System Installed at the Paloma and Cabrillas Mines

In an article by W. W. Adams, appearing in the *Journal* of Jan. 19, the statement was made that the difference of the check base line, as actually measured from the computed length, was 0.0008 inches. This should have been 0.0008 meters.

Ore Concentrating Method, patented by A. Schwarz, of Joplin, Mo., is described in *Journ. Soc. Chem. Ind.*, Oct. 31, 1917, as follows: "A gas other than air is delivered through the perforated false bottom of one compartment of a closed vessel containing ore pulp and 'modifying agents.' The rising bubbles containing metalliferous particles flow over a partition into the adjacent compartment, which is provided with a liquid seal, where the solid material is precipitated by a liquid spray. The liberated gas above the pulp mass is withdrawn and redelivered to the bottom of the pulp compartment. Air is excluded from the system."

Events and Economics of the War

Seizure of Dutch ships in American waters by the Government was to have been made on Mar. 18, but action deferred; about 470,000 tons is involved.

The Calder daylight-saving bill and the Administration's railroad bill were signed by the President. A new office was created when Walter S. Gifford, director of the Council of National Defense, was made director of the Aircraft Production Board; a special committee under H. Snowden Marshall, of New York, was appointed with a view to speeding up the aircraft production program.

Abroad, the Russian Congress of Soviets at Moscow ratified the treaty of peace with Germany. Odessa was occupied by German troops, the Russian fleet there escaping to Sebastopol. The Turks reëntered Erzerum, in Asia Minor. Gains in Palestine were reported by the British. Various raids occurred on the Western front, including one on Paris in which 100 were killed. An attack by one or two Zeppelins on the northeast coast of England accomplished nothing.

Must Maintain the Gold Reserve, Says Redfield

"Our power to grant credits at home and abroad depends on maintaining our gold reserve, which is the basis for those credits," said Secretary of Commerce Redfield in a recent issue of the *Sun*. "If that gold reserve is greatly diminished there will be less credit available at home. We shall not be able to look abroad, as before the war, for a supply of credit. We must furnish it ourselves. I know of but four ways to protect the reserve on which these credits depend. These are loans abroad, investments abroad, sales abroad or services abroad. Our ability to keep a supply of credits sufficient for our domestic business depends upon these four things.

"The enemies against which the American manufacturer must fight in protecting our domestic credits by selling goods abroad are chiefly domestic. Four are of especial importance. First I should put the failure to apply science to industry. Germany did this more than any one and prospered thereby. The use of science in industry has greatly grown during the last three years. It must grow more. Unless we are as competent to apply science to trade as others we must not expect to lead them successfully. We shall not deserve to win in the future industrial field unless we apply knowledge to industry as well as others.

"A second enemy is the lack of industrial training for workers. In German factories before the war men of science led forces of trained workers. We have made a great start in this direction through the law providing Federal aid to vocational education, of which every state in the Union has now taken advantage. This act will, in my judgment, be found to be more helpful to American industry in coming years than many things that have been more visible to the public eye. When we have trained minds leading trained workers two great steps forward will have been taken in American industry.

"A third enemy is ignorance of costs. This has prevailed to an appalling extent. It must go, and with it must go the rule of thumb and all guesswork in industry if we are to deserve the place we hope to gain and keep. We cannot compete with men who know what every process costs them if we have not like knowledge ourselves.

"A fourth enemy—and a bad one—is waste. We have thrown away fortunes in the wastes of industry. Take, for a simple illustration, the whaling industry. This is one of our oldest, carried on for over a century with what we have been pleased to call great success. Now we know that most of the values of the whale have been wasted. Fine leather is now made from the whale's skin, from the intestines, the stomach and from other parts. Several tons of good meat are now taken from each whale and find regular consumption. These and similar things may soon come to be the chief products of an industry which for decades has thrown them away.

"If we will waste we must expect to want. Waste in one or another form has been and, though greatly reduced, still remains one of the great characteristics of American industry and life. We have learned much and are feeding nations from what we now save, but there is much yet to learn.

"There are many fine examples in our industry of science applied to business, of trained workers, of clear knowledge, of watchful saving. An indirect good from the war has been the lessons we have learned on these subjects. On the extent to which we learn them and apply them will chiefly depend the future of American business. That future must be one in foreign fields, for the output of our factories is too large for our domestic markets continuously to take it all. Nor can we maintain our domestic credits under the altered conditions by sales in the domestic market alone."

To Centralize Railway Purchases

Partial centralization of the purchasing of between $1,000,000,000 and $2,000,000,000 worth of railroad supplies and equipment in 1918 under Government supervision is involved in the plan for organizing the Railroad Administration's division of finance and purchases recently announced by Director General McAdoo. John Skelton Williams, head of this division, has appointed a central advisory committee of three expert railway purchasing agents, as well as regional purchasing committees for the Eastern, Western and Southern operating regions. Details of costs and contracts will be reported to the Railroad Administration by the regional bodies, to give all roads the advantage of efficient methods that may have been developed. More than a hundred million dollars will be saved by centralized purchasing, it is believed.

Through the central organization will be bought locomotives, cars and steel rails, the principal big quantity purchases of railways, and an effort will be made not only to economize by wholesale buying methods, but to standardize equipment and supplies. Coal and other fuel will be bought mainly by individual lines to supply their individual needs, but under the supervision of the regional committees. In New England, fuel is to be purchased by a special committee. Cross ties and lumber are to be bought principally by the roads along their own lines, but may be ordered through the central organization if they cannot be bought in the territory through which the road passes.

"All other supplies needed for current operations will be purchased for the time being," says Director General McAdoo's statement, "through the purchasing departments of the respective roads, but all contracts for periods of six months or longer must be approved by the regional committee before completion." As fast as possible, all purchases will be centralized.

The central advisory purchasing committee, with headquarters at Washington, is composed of Henry B. Spencer, vice president of the Southern Ry., in charge of purchases and chairman of the committee on materials and supplies of the American Railway Association's special committee on national defense; Samuel Porcher, of Philadelphia, general purchasing agent of the Pennsylvania system since 1913, and George G. Yeomans, purchasing agent of the New York, New Haven & Hartford R.R. since 1915. The finance section of the advisory committee includes Franklin Q. Brown, of New York; Festus J. Wade, of St. Louis; and Frederick W. Scott, of Richmond, Virginia.

Post-War Questions Considered Now in Great Britain

Consul General Robert P. Skinner, in London, has reported to the Department of Commerce at Washington that the British Ministry of Reconstruction has just published a complete list of the various commissions and committees that have been set up, both within that ministry and within other ministries and departments of the British government, to deal with questions which will arise at the close of the war. These commissions and committees, which have been appointed at different times since the war began, now number 87 and fall into the following 15 groups: Trade development; finance; raw material; coal and power; intelligence; scientific and industrial research; demobilization and disposal of stores; labor and employment; agriculture and forestry; public administration; housing; education; aliens; legal; and miscellaneous.

Under the grouping of trade development are five committees dealing with general aspects and nine dealing with specific phases of the situation. Preparation has been made for every line of trade activity that will be needed to build up the food supply of the United Kingdom and extend foreign commerce. One commission deals with the food and other resources of the five self-governing dominions. Another is in charge of a plan to develop the industrial resources of India; a third has to do with trade between England and Belgium. Special study is given to carrying out the conclusions reached at the Paris Trade Conference, Mr. Skinner states, and to meeting the changed trade conditions of the world after the war.

Measures are being devised to prevent an effective resumption of Germany's policy of peaceful penetration. Staples not made in England before the war are hereafter to be manufactured there, and especial attention is being given to the chemical and dye trades. In view of the heavy consumption of England's coal supply, effort is being exerted to establish a general policy of conservation after the war. The problem of atmospheric nitrogen fixation, which has been such a powerful element of Germany's military advantage, is among the problems that the Ministry of Reconstruction is working upon. Another problem under consideration is the demobilization of the vast amount of labor diverted from its original occupations to war trades.

Building Ordnance Base in France for U. S. Army

An ordnance base that will cost approximately $25,000,000 is under construction in France, and good progress in building is reported, according to an announcement of the War Department. In the base will be approximately 20 large storehouses, 12 shop buildings, 100 smaller shops and magazines and machine tool equipment costing about $5,000,000.

The project includes a gun-repair plant equipped to reline more than 800 guns a month; a carriage repair plant of large capacity; a motion-vehicle repair plant, capable of overhauling more than 1200 vehicles per month; a small-arms repair plant with a capacity for repair of some 58,000 small arms and machine guns per month; a large shop for the repair of horse and infantry equipment, and a reloading plant capable of reloading about 100,000 artillery cartridge cases per day. There will be, in addition, forges, carpenter shops, and other auxiliary buildings.

Much of the construction material and equipment has arrived in France, and actual construction was begun several weeks ago. Practically all of the essential materials have been contracted for, and priority orders issued by the War Industries Board have expedited deliveries. It is estimated that for the maintenance of the ordnance base approximately 450 officers and 16,000 men will be required. Some difficulty was experienced in obtaining the initial units trained in manufacturing industries.

Causes of Strikes Analyzed

Increased cost of living and failure of employers in many cases to anticipate this influence have been among the important contributory causes of recent strikes, according to the report issued on Mar. 12 by the National Industrial Conference Board on strikes in American industries in war time.

From Apr. 6 to Oct. 6, 1917, there were strikes at 2521 establishments, the existence of which was definitely verified by the board. Each establishment was asked to report upon causes, but complete information was received from only 1156. These plants showed 283,402 men idle and 6,285,519 days of production lost.

The conclusions of the board as to the causes of the

unsettled condition of labor are that the following influences were of primary importance: Increased cost of living and failure of employers in many cases to anticipate this influence; widespread discontent due to a belief that undue profits had been made by employers out of war business; increased independence of the worker, due in part to a labor shortage and in part to a feeling that the situation constituted labor's opportunity for forcing union recognition or closed-shop conditions; inequality between wages paid in plants engaged on private work and Government or private plants engaged on war work; the unsettling influence of the "cost-plus-profit" feature of many war contracts; the Federal Administration's virtual indorsement of the eight-hour work day.

The report concludes: "Indications of improvement in the labor situation in recent months are apparent, but it needs only a cursory reading of the daily press to see that the war industries of this country are still heavily handicapped by labor disputes."

Have You Filed Your Tax Return?

Twenty five thousand "four-minute men" are making a nation-wide campaign to impress on the public its duty to file income-tax returns and pay the taxes promptly. Filing must be done before Apr. 1. The penalty for failure is a fine of not less than $20 nor more than $1000 and an additional assessment of 50% of amount due. Tables are being produced comparing the rate of the tax in the United States with that in Great Britain. Here the married man with an income of $2500 pays $10. In Great Britain the man with an income of $2500 pays a tax of $225, and $300 if his income is not earned but is from interest on bonds or the like. As the income increases the difference between American and British taxes become less, and finally when million-dollar incomes are reached the amount paid in this country is greater than in Great Britain.

To Push Munitions Production

Plans of the War Department were announced recently by General Wheeler, acting Chief of Ordnance, for dividing the country into 10 munition districts to bring about decentralization and closer contact with manufacturers. Headquarters will be established in a city in each zone, from which a leading business man has already been selected to be district chief of the production division of the Ordnance Department. The cities and men selected are as follows:

Pittsburgh, Ralph M. Dravo, of Dravo Brothers, steel constructors; Cleveland, Samuel Scovil, who resigned as president of the Cleveland Illuminating Co. to head the production division; Rochester, F. S. Noble, of the Eastman Kodak Co.; Boston, Levi H. Greenwood, of the Wakefield Rattan Co.; New Haven, Waldo C. Bryant, president of the Bryant Electric Co. of Bridgeport, Conn.; Detroit, Fred. J. Robinson, president of the Lowrie & Robinson Lumber Co.; Cincinnati, Charles L. Harrison, of the Cincinnati Chamber of Commerce; Chicago, E. A. Russell, vice president of the Otis Elevator Co.; New York, Samuel G. Allen, chairman of the Lima Locomotive Works, 1107 Broadway; Philadelphia, John C. Jones, of the Harrison Safety Boiler Works.

Col. Guy E. Tripp, of New York, ex-chairman of the Westinghouse company, and now chief of the production division of the Ordnance Department, worked out the details of the plan.

Taxation of a Mining Company

The Bureau of Internal Revenue gives the following answer to a question respecting the taxation of the profits of a mining company:

In 1900 a corporation was organized and took over a mining property then valued at $1,000,000. For this property the corporation issued stock to the amount of $1,000,000. As a result of development, the discovery of new orebodies, etc., the property increased in value until in 1910, after an appraisal, it was entered on the books at $10,000,000, and the surplus was increased accordingly. In 1917 another appraisal was had, and the value of the property was then fixed at $15,000,000. The balance sheet of the corporation now shows capital stock of $1,000,000 and a surplus of $20,000,000, of which $14,000,000 is represented by the appreciation in value above described. May the appraising value of the property be taken as the basis for computing invested capital?

A. No. The excess-profits tax law expressly places the computation of invested capital upon the basis of the cash and other property actually put into the business plus the earned surplus and undivided profits, and not upon that of a present valuation or appraisal of its assets. Returns in which the invested capital includes surplus or undivided profits computed upon present values as determined by an appraisal cannot be accepted.

United States Will Spend $400,000,000 on War Buildings

Approximately $400,000,000 is to be spent by the Government in 1918 for construction work to put the country on a war footing, that it may properly equip the Army and Navy and build up a huge emergency supply. Over $200,000,000 has already been spent in building the 16 cantonments and in other work now practically completed. The $400,000,000 will be spent as follows:

Development of six distribution points or ports on the Atlantic seaboard, with dockage and storage facilities, $90,000,000; for 31 storage warehouses in the interior manufacturing districts of the East and Middle West, $100,000,000; for two Government-owned powder plants, $100,000,000; for buildings for Signal Corps, $50,000,000; for other construction, including plants for manufacture of gases and ingredients entering into high explosives, $60,000,000.

Air Service Needs Skilled Workers

Ten thousand machinists, mechanics, chauffeurs, and other skilled workers are needed at once by the Aviation Section, Signal Corps. This call is to fill an immediate need and may be regarded as the precursor of others as the service is being built up. Even at that, the actual strength of the service today is over 100 times what it was on Apr. 1, 1916.

The dependence of the air service on the most highly skilled men is being brought out more emphatically with every week of development. Practically 98 men out of every 100 must be skilled in some branch of work. Men registered in the draft may be inducted into this service by applying to their local draft board. Men not registered may enlist at any recruiting office. Further information may be had by applying to the Air Division, Personal Department, Washington, D. C.

Remember the Comfort Fund of the 27th Engineers.

Industrial News from Washington

BY PAUL WOOTON, SPECIAL CORRESPONDENT

Mineral Statistics To Be Collected More Frequently

To supply Government agencies engaged in war work promptly with necessary data concerning various minerals, the U. S. Geological Survey has agreed to collect statistics more frequently from producers, consumers and others connected with the trade in the following metals and minerals: Nickel, aluminum, graphite, manganese, chromite, quicksilver, flourspar, bromine, magnesite and tungsten. Statistics of primary aluminum will be collected weekly, while monthly figures will be secured on the secondary metal. Statistics showing the production, stocks and consumption of nickel are to be collected monthly. Data with regard to the other commodities mentioned are to be collected quarterly.

Mineral Board Is To Handle Questionnaires

Questionnaires in the future will be submitted to the Joint Board on Minerals and Their Derivatives to avoid troubling producers unnecessarily with Government inquiries. In this way, all duplication will be avoided. It also will make possible the securing of data for several Government agencies at the same time.

The volume of business passing through the office of the board, which is the clearing house for all Government information pertaining to minerals, has exceeded estimates, and it has been necessary to assign F. J. Katz, of the Geological Survey's staff, to the board. Mr. Katz will act as assistant to E. S. Bastin, the secretary of the board. He will also continue in charge of abrasives for the Survey.

Mexican Mineral Statistics

Gold, silver, copper and lead produced in Mexico for the four years ended Dec. 31, 1917, had an aggregate value of $166,000,000 American currency, according to an estimate made by the Department of Fomento and made public by the Mexican News Bureau in Washington. Exact figures are available for the 36-year period between 1877 and 1913, showing the production of the metals mentioned to have been valued at slightly more than $1,500,000,000, U. S. currency. From 1877 to 1913 the output of gold was 934,694 lb.; of silver, 113,769,533 lb.; of copper, 1,540,000,000 lb.; of lead, 3,464,008,249 pounds.

Other facts ascertained by the Minister of Fomento are as follows: The largest gold production was in the fiscal year of 1911-12, when it amounted to 80,113 lb. It was lowest in 1885. In 1911-12, silver production aggregated 5,500,000 lb., which is the record year of the period under view. The low mark of silver production was in 1877, when only 1,335,279 lb. was mined. The fiscal year of 1911-12 also was the highwater mark of copper production. In that year, 132,000,000 lb. was mined. The other extreme was in 1897-98, when production totaled 24,857,795 lb. The peak of load production was in 1909-10, when it amounted to 275,658,499 lb. In 1896-97, lead production amounted to 121,000,000 pounds.

For Greater Chromite Production

Activities of the California Chrome Co. to increase the production of chromite on the Pacific Coast have called forth much official commendation. The company is about to begin an advertising campaign in several hundred local newspapers, calling attention to the fact that it will pay a minimum of $1.25 per unit for ore which will run 38% chromic oxide. The price is guaranteed throughout the current year.

Officials have been advised from a highly authoritative source that a large increase in Cuban chromite production may be expected. The chief factor limiting production in Cuba is the difficulty of getting the ore to the railroad. Mules are used, which renders transportation slow and expensive.

Arguments Over Quality a Source of Loss of Output

Squabbles over the grade of materials, when taken the country over, are resulting in a material loss of production, reports to Washington show. This is particularly so in the case of those things which cannot stand shipment to sampling works. In some cases these differences have caused the closing of mines.

The situation has led certain officials seriously to consider the creation of machinery to enable an agent of the Government who would have the confidence of producer and buyer alike, to specify the grade of any material where differences of opinion between producers and buyers warrant it. The situation has been rendered acute under the present conditions, which have forced purchasers in many cases to combine to maintain a single buyer in a mining district.

Greater Manganese Production Is Forecast

After careful study of the manganese situation, officials of the U. S. Shipping Board, War Trade Board and War Industries Board believe that the domestic production of low-grade manganese ore will be increased this year from 500,000 tons to 800,000 tons, and that the high-grade manganese ore production will be increased from 125,000 to 175,000 tons. The practical certainty of this will permit of a considerable reduction to be made in the tonnage assigned to the Brazilian manganese trade. Producers are being urged,

as a patriotic duty, to increase their output to the maximum. Every pound of domestic manganese ore produced saves that much cargo space on the long trip to Brazil and back. One of the essentials in securing the maximum domestic development is held to be the standardization of prices. At present the producer is surrounded by a great deal of uncertainty as to the amount he is to receive for his product.

Conflict in Freight Rates Removed

Mine cars and dump cars are entitled to freight classification as mining machinery, which is allowed a lower rate than the tariff provides for mining and dump cars. A ruling to this effect has been made by the Interstate Commerce Commission in the case of the United Verde Copper Co. vs. the Pennsylvania R.R. The carriers collected the higher freight rate for mining and dump cars, but are instructed to refund the difference between that rate and the rate on mining machinery. "The tariff contained conflicting items," says the opinion, "and the shipper is entitled to the lower of conflicting rates."

Testing the Caron Process at Golden Station of Bureau of Mines

Treatment of manganese-silver ores by the Caron process is progressing satisfactorily at the Golden station of the U. S. Bureau of Mines. The work is being done jointly by the Bureau, the Netherlands government and the Research Corporation, G. H. Clevenger being in charge for the Bureau. The Golden station was selected for this experimentation because of the large bodies of manganese-silver ores in Colorado. In some places the deposits are so laid down as to permit mining by steam shovel. While the main object of the Caron process is to recover the silver by leaching and precipitation, it also takes into account the saving of manganese as a byproduct.

Colville Reservation Promising in Mineral Deposits

Extension of transportation facilities to the Colville Indian reservation in Washington would be followed by much more important mining activity than exists in that region at present, according to J. T. Pardee, of the U. S. Geological Survey. "Silver is the principal valuable constituent in most of the veins and shear zones," says Mr. Pardee. "As a rule, lead is associated with the silver, and in some deposits it is of equal value. Zinc is almost as widely distributed and as abundant as lead. Copper is present in many deposits, but except in some of the larger shear zones and disseminated deposits it is of little value. Gold occurs sparingly in most of the lodes, but in few does it add materially to the value of the ores. Antimony and molybdenum are possibly important in exceptional localities. In view of the evidences of mineralization exhibited in the mining districts, the possibilities of finding bonanzas are by no means lacking. The developments made so far have shown, in addition to a few rich orebodies, many comparatively small ones of medium to low grade that could be worked profitably if cheap transportation were available."

Ingredients of Fertilizers Licensed

Dealings in sulphuric acid, phosphate rock and acid phosphate were placed under Government license on Mar. 20; likewise sodium nitrate, ammonium sulphate, cyanamid, calcium nitrate, potash salts, cement dust, blast furnace dust, kelp ash, potassium nitrate, sulphur and all fertilizers and fertilizer ingredients. The supervision of the control of the fertilizer industry is to be in the hands of the Secretary of Agriculture.

Potash Made in Central America

Potassium nitrate is being manufactured in small quantities in Guatemala, other Central American countries and in Mexico. The Department of Commerce is advised that certain interests in Mexico City are prepared to make small shipments by way of Vera Cruz. It is known that the sources from which some of this material is coming were examined by various interests last summer. The opinion of those who conducted the work is that every encouragement should be advanced to secure a maximum output. Production is certain to be small, but should be stimulated because of the need of the mineral. Potash deposits in northern Chile are again attracting attention, according to reports to Washington. They were carefully examined a year ago by New York financial interests and, though details have not been made public, it is believed that potash in considerable amounts occurs in certain places.

Next Draft To Be Classified Physically

Reclassification according to physical condition of the men called in the next army draft is required in revised instructions for Medical Advisory Boards which are being sent to local boards throughout the country. The new regulations, recently made public, require that every man summoned shall be placed in one of these classes:

(A) Acceptable for general military service; (B) acceptable for general military service after being cured of remediable defect; (C) acceptance for special or limited military service in a specified capacity or occupation; (D) rejected and exempted from any military service.

It is the intention of the Provost Marshal General to provide later for further investigation and classification of the men acceptable for limited or special service, so that a record may be made of the sort of work each man can do without endangering his health. Under the new regulations many ailments and defects which previously gained exemption for drafted men will result only in their being listed in Group B. Such men, if they choose, will have the privilege of obtaining the services of their family physicians in the effort to remove the defect, but if they have not taken this opportunity within a stated time they will be called into service and sent to a cantonment base hospital, reconstruction hospital, or civic hospital, as designated by the Surgeon General.

Pegasus Goes Over the Top

Mule skinner? We should say not. It was Private Fithingham, 27th Engineers, taking Pegasus out for a spin. It must be hard sledding for Peggy in the mining regiment, as there's no provision there at all for cavalry. Perhaps, like Captain Jinks of the horse marines, Fithingham feeds his steed on corn and beans. At any rate, this rhyming engineer sent us a poem, the first stanza of which runs thus:

> We're a regiment of husky miners,
> Enlisted of our own free will;
> We will tunnel through to Berlin
> And blow up Kaiser Bill.

Lack of space prevents us from publishing it *in toto*. We will, however, send a copy to any reader desiring it, provided he first sends us a contribution in real money for the Comfort Fund. The list of contributors to the Fund has made its regular weekly stride and stands as follows:

Engineering and Mining Journal	$1000.00
New York Engineering Co.	1000.00
A Friend, Nov. 23	5.00
H. H.	5.00
D. E. Charlton	5.00
H. W. Hardinge	1000.00
Frank N. Spencer	5.00
W. L. Coursen	5.00
J. H. Polhemus	5.00
J. H. Janeway	10.00
Albert D. Beers	10.00
J. E. Hayes	10.00
J. A. Van Mater	25.00
L. Vogelstein & Co.	100.00
"Cuprite"	10.00
R. H. Bassett (Hanna Ore Mining Co.)	10.00
A Friend, Dec. 10	10.00
P. A. Mosman	10.00
American Zinc, Lead and Smelting Co.	100.00
J. G. H.	5.00
Daniel Guggenheim	100.00
A. H. H.	5.00
Willard S. Morse	25.00
August Heckscher	100.00
Anaconda Copper Mining Co.	1000.00
F. W. Bradley	100.00
Charles Le Vasseur	5.00
A Friend, Dec. 13	50.00
Freeland Jewett	10.00
Herman A. Wagner	5.00
Francis P. Sinn	10.00
R. C. Gosrow	5.00
D. C. Jackling	100.00
"V"	10.00
J. H. Brickenstein	5.00
E. E. Northrup	5.00
Rogers, Mayer & Ball	50.00
Denver Technical Staff, American Metal Co., Ltd.	30.00
A Friend, Jan. 9	100.00
E. B. Coolidge	10.00
J. V. N. Dorr	200.00
Pope Yeatman	50.00
W. H. Aldridge	50.00
C. E. Hart	5.00
Robert I. Kerr	5.00
Engineers of Washoe Smeltery, Anaconda Copper Mining Company	205.00
Harry C. Graham	25.00
Utah Copper, Nevada Consolidated, Ray Consolidated and Chino copper companies	1000.00
A Friend, Jan. 23	5.00
John Gillie	25.00
J. N. Houser	5.00
C. K. Lipman	50.00
Theodore Sternfeld	50.00
Clinton H. Crane	500.00
T. Wolfson	10.00
William H. Hampton	10.00
W. E. Merriss	10.00
J. Parke Channing	100.00
Miami Copper Co.	250.00
J. H. Means	10.00
C. W. Goodale	25.00
P. G. Beckett	50.00
F. R. Foraker	25.00
Charles A. Chase	25.00
E. Fleming L'Engle	5.00
Calumet & Hecla Mining Co.	250.00
H. G. Ferguson	18.00
Jay E. Van Gundy	10.00
Franklin Osborn	10.00
Oscar Lachmund	10.00
W. T. Swoyer	10.00
Interest	10.00
Quincy Mining Co.	100.00
American Metal Co.	250.00
William H. Fairbanks	25.00
D. E. Curry	5.00
W. R. Ingalls	50.00
H. A. Guess	25.00
J. Mc. C.	5.00
Engineers' Club of Northern Minnesota	85.00
B. B. Thayer	50.00
R. H. Sales	25.00
Albert C. Burrage	100.00
Edward H. Clark	25.00
P. Rutherford	5.00
Adolph J. Martinson	2.00
Frank R. Edwards	5.00
C. H. Munro	100.00
E. E. McCarthy	25.00
J. L. Bruce	15.00
D. Ford McCormick	10.00
Louis D. Huntoon	5.00
P. G. Spilsbury	10.00
C. T. Brown	10.00
M. C. M.	3.00
James F. McCarthy	50.00
United States Smelting, Refining and Mining Co.	250.00
L. O. K.	10.00
Herman A. Prosser	25.00
J. E. Johnson, Jr.	5.00
A. W. Hahn	5.00
L. D. Hudson	10.00
Lane Pearl	5.00
Arthur K. Adams	10.00
L. L. Wilcox	5.00
E. J. Longyear Co.	100.00
Pick and Shovel Club, Mining Department, Case School of Applied Science	11.00
L. S. Cates	25.00
Total	$9514.00

"The 27th Engineers strikes near home," write the E. J. Longyear Co. in sending in their check. To many engaged in the mining industry it strikes directly in the home. We must stand by our own. For that purpose the Association of the 27th Engineers was formed. Make your checks payable to W. R. Ingalls, treasurer. In view of the considerable detail work in the administration of this Fund, acknowledgment of contributions is made only through publication in the *Journal*.

Cowperthwaite on Safety First

According to *State Safety News*, Thomas Cowperthwaite, safety inspector of the Calumet & Arizona Mining Co. and its subsidiaries, spoke recently before the mining club of the Bisbee Y. M. C. A., giving many suggestions on accident prevention, of which a few excerpts are as follows:

"A safety inspector needs all the power he can get. If he is general manager or superintendent, he can put any idea he may get into force without bothering to collect data for a long time. The next best thing is to have all the biggest bosses on committees. In that way, things which are wrong can be remedied on the minute."

For instance, one afternoon Mr. Cowperthwaite found three dangerous places. The superintendent was on the commission and ordered the carpenters to go fix matters at once. Before the shift was over all three holes were safe. Getting action that quick may have saved three men's lives or prevented bad accidents. That kind of Safety First gets results.

Mine committees, in Mr. Cowperthwaite's scheme, are made up of bosses. He is not willing to put miners on the committee, for fear a boss might get "down" on some fellow who suggests a safety plan the boss does not care for. And besides, if the bosses are on safety committees the prevention of accidents becomes part of their regular business. In 1916 only two bosses had a clear record on accidents; in 1917 14 had. The first half of 1917, of course, was far safer than the second, but the whole year 1917 had not so many accidents as 1916, partly because the men have not been rushed so much, but largely on account of the safety organization. Mr. Cowperthwaite further declared:

"Most accidents occur about 11 a.m. or 1 p.m. A

poor boss will insist on telling only one thing at a time, and having that done before he gives away his next move. That means that the miner has time to burn until about 10 o'clock, when the shifter tells him what to do. He kills time, moving, lagging around. Then, when it's nearly time to shoot he has to rush like fury to get ready. Unless the miner is cooler and more farseeing than the shifter, he will be bound to pull a bonehead and knock a rock the wrong way, upset his machine or do something else to get hurt. It makes things worse for the shifter to bawl him out.

"A man who is bossing ought to be an artist in handling men. If he is crabbed or hot-headed it's almost impossible for him to make good at anything but a rawhider. A good shifter gets things done and demands a fair day's work of a man, but takes it for granted that the fellow will either do it or leave. It's poor taste for any boss to fire a man on account of some grudge. If he does people can tell that the boss' judgment on other things is apt to be just as poor. The good, old golden rule is about the best instruction a shifter can get as to the way to get along. If a shifter likes to be bawled out himself, he should do it to the men under him; otherwise not.

"The safety record of each shift boss in the C. & A. mines is kept and checked up. A prize of $100 was given last year for the best record, but that is not a permanent policy. Anyway, a shifter hates to have his record beaten. The man who wins talks to his men, knows how they do things and prevents many unsafe practices. He knows it if some fellow has been carrying powder around in his pockets, mixed up with fuses and caps, and dangerously near the flame of his miner's lamp. One man whose record was very low said that naturally another would have a clean record. 'Why, he goes around crying for it.' That kind gets it. And a fellow who rawhides his men loses out on the amount produced as well, because he has to break in too many green hands. That makes more work for the older men and increases their accident rate at the same time.

"New men naturally are hurt oftener than old. The danger point is about six months, when a new man thinks he knows far more about the job than his boss. Married men have less long layoffs than single, and foreigners who cannot speak English give a large accident rate. The C. & A. is at the present time employing 90% Americans.

"Records are kept in all manner of ways. The number as well as the percentage is recorded in the safety data. A foreman will wilt into his seat when the safety man remarks, 'You have had nine serious accidents during the last six months.'

"Of direct causes of accidents, those that the company could have prevented are about 2%. Carelessness of the man injured or of fellow-workmen and trade risks account for the rest. The company is perfectly willing to pit its record against others.

"And, finally, a good boss lets the men in on his scheme of work. He keeps one man on the same place for a while and lays out the work for a week ahead. Then a man knows what to do and does not have to loaf or make woodpiles around various places until orders come. He can take time, be careful, get the job done in his own way and not be hurried at one time to make up for forced and joyless loafing. If bright and inventive, he can use his own shortcuts and inventions, and is not provoked by anger and disgust to bitter carelessness."

Production of Aluminum and Tin from 1900 to 1917

The production of aluminum in the United States grew from 7,150,000 lb. in 1900 to 18,000,000 lb. in 1917, according to figures tabulated by the National City Bank of New York. The latter figure is an estimate based upon an actual production in 1916 of 139,000,000 lb. Statistics showing the imports as well as the pounds produced in each year of the 17-year period are given in the following table:

PRODUCTION AND IMPORTS OF ALUMINUM IN THE UNITED STATES, 1900–1917

	Production (*a*)			Imports (*b*)		
Year	Pounds	Value	Stated Value Cents Per Lb.	Crude Pounds	Crude Value	Mfrs. Value
1900	7,150,000	$1,920,000	26.9			
1901	7,150,000	2,238,000	31.3	365,000	$62,000	$4,000
1902	7,300,000	2,285,000	31.3	558,000	128,000	7,000
1903	7,500,000	2,285,000	30.5	687,000	197,000	3,000
1904	8,600,000	2,477,000	28.8	363,000	100,000	4,000
1905	11,347,000	3,246,000	28.6	639,000	153,000	6,000
1906	14,910,000	4,262,000	28.6	614,000	123,000	9,000
1907	17,211,000	4,927,000	28.6	1,292,000	259,000	9,000
1908	11,152,000	2,435,000	21.8	114,000	30,000	6,000
1909	34,210,000	6,575,000	19.2	2,036,000	308,000	6,000
1910	47,734,000	8,956,000	18.8	12,386,000	1,841,000	24,000
1911	46,125,000	8,084,000	17.5	6,241,000	946,000	32,000
1912	65,607,000	11,907,000	18.1	14,803,000	1,830,000	239,000
1913	72,379,000	13,845,000	19.1	26,958,000	4,315,000	740,000
1914	79,129,000	14,523,000	18.4	15,964,000	2,707,000	1,441,000
1915	99,806,000	17,986,000	18.0	13,765,000	2,346,000	653,000
1916	139,000,000	33,900,000	24.4	8,201,000	1,827,000	150,000
1917 (*c*)	180,000,000	45,882,000	26.2	1,904,000	559,000	43,000

(*a*) Geological Survey figures; (*b*) Department of Commerce figures; (*c*) Estimated.

The increase in production of aluminum in the United States during this period was paralleled by a corresponding increase in the world's production of the metal. The latter rose from 7200 long tons in 1900 to 135,000 long tons in 1916. The world's production of tin is also estimated by the National City Bank to have increased from 77,200 long tons in 1900 to 117,500 long tons in 1916. The figures by years follow:

ESTIMATED WORLD PRODUCTION OF ALUMINUM AND TIN 1900 TO 1916

Year	Aluminum, Long Tons	Tin, Long Tons
1900	7,200	77,200
1901	7,400	84,700
1902	7,700	88,000
1903	8,100	89,000
1904	9,200	92,400
1905	11,300	90,500
1906	14,300	96,700
1907	19,500	92,300
1908	18,300	104,100
1909	33,300	104,200
1910	49,100	103,500
1911	49,600	109,600
1912	72,400	114,600
1913	78,100	119,000
1914	82,500	107,000
1915	91,100	121,800
1916	135,000	117,500

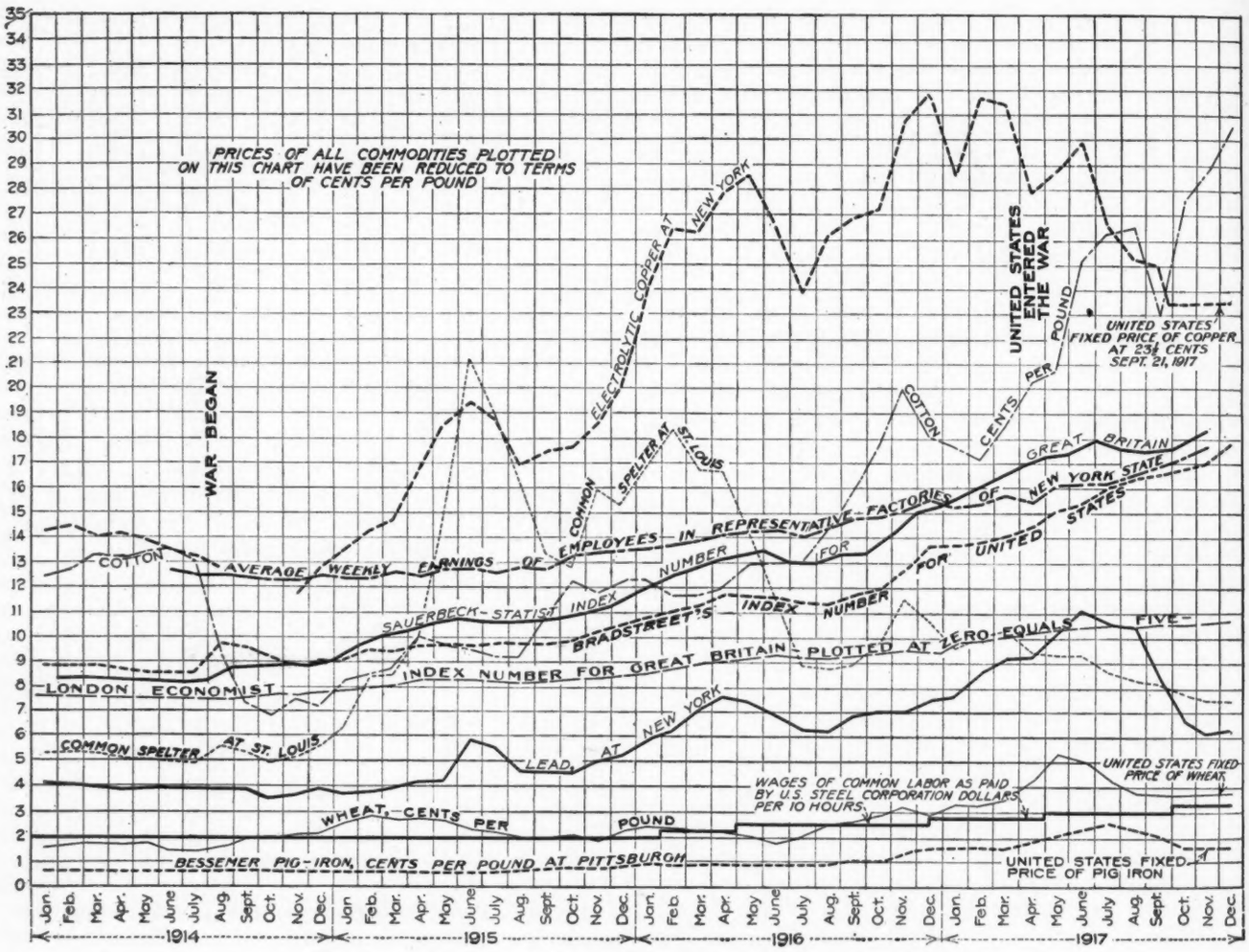
In the latest normal year, the world's supply of aluminum came principally from seven countries besides the United States. The figures for each country in that year are as follows: United States, 65,000 long tons; France, 20,000; Switzerland, 20,000; Norway, 16,000; Great Britain, 12,000; Canada, 8000; Italy, 7000; and Austria, 5000. Pre-war figures are given for Switzerland, Great Britain and Italy.

The world's production of tin by principal countries in the latest normal year was as follows: Malay Peninsula, 44,000 long tons; Bolivia, 21,000; Dutch East Indies, 20,000; China, 8000; Siam, 7000; Africa, 5000; Great Britain, 4500; and Australia, 4500 long tons.

Editorials

The Rise in Prices

THE accompanying chart shows the course of prices since the beginning of 1914, plotted from the monthly averages; also the several index numbers; and, finally, some data respecting the wages for labor. The prices for all commodities have been reduced to the uniform basis of cents per pound. Data respecting the wages for labor are difficult to find. The only index number of this sort in the United States, whereof we know, is that of the New York State Labor Bureau, which is deduced from the reports from a large number of factories of a large number of industries in this state. This is probably a pretty reliable index of labor conditions in this part of the country. As reflecting the status of common labor, we can think of nothing better than the rates paid by the U. S. Steel Corporation, which is a very large employer.


PRICES OF ALL COMMODITIES PLOTTED ON THIS CHART HAVE BEEN REDUCED TO TERMS OF CENTS PER POUND
WAR BEGAN
ELECTROLYTIC COPPER AT NEW YORK
UNITED STATES ENTERED THE WAR
UNITED STATES FIXED PRICE OF COPPER AT 23½ CENTS SEPT. 21, 1917
COTTON CENTS PER POUND
SPELTER AT ST. LOUIS
COMMON
GREAT BRITAIN
NEW YORK STATE
UNITED STATES
COTTON AVERAGE WEEKLY EARNINGS OF EMPLOYEES IN REPRESENTATIVE FACTORIES OF
FOR
NUMBER
INDEX
SAUERBECK-STATIST
BRADSTREET'S INDEX NUMBER
FIVE-
PLOTTED AT ZERO EQUALS
INDEX NUMBER FOR GREAT BRITAIN
LONDON ECONOMIST
COMMON SPELTER AT ST. LOUIS
LEAD AT NEW YORK
UNITED STATES FIXED PRICE OF WHEAT
WAGES OF COMMON LABOR AS PAID BY U.S. STEEL CORPORATION DOLLARS PER 10 HOURS
WHEAT, CENTS PER POUND
BESSEMER PIG-IRON, CENTS PER POUND AT PITTSBURGH
UNITED STATES FIXED PRICE OF PIG IRON
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1914
1915
1916
1917

PRICES OF METALS AND COMMODITIES AND WAGES OF LABOR

The index numbers for commodity prices are supposed to reflect the wholesale, basic values. They are more or less empirical; i. e., each authority has a different method of computation. No one of them is quantitative; i. e., no one of them takes into account the relative proportions of the several commodities that are produced and consumed. Therefore these indices, far from being absolute, may differ materially from each other. Thus will be noted the discrepancy between the Economist and Sauerbeck-Statist numbers for Great Britain. They may be properly regarded as showing only approximately the general trend of prices. In this connection it may be further remarked that since the early part of 1916 the average quotations for some of the major component commodities have tended to become higher than the prices for which the bulk of the commodities have been sold, and this has contributed to an exaggeration of the index numbers at certain times, though there is, of course, no exaggeration of the rise in commodities over a long period on this account.

The index numbers for commodities exhibit relatively even trends when viewed over long periods. When an-

alyzed into their components, however, the graphs naturally show great irregularities, which are magnified in the cases of the high-priced commodities such as copper and cotton. Peaks of the several commodities do not always coincide, for the reason that any one may be affected by conditions peculiar to itself.

Thus, among the metals, zinc was the first to attain a climax, which occurred about the middle of 1915, an early date compared with any of the other major commodities. This climax coincided with preliminary peaks in lead and copper, but, while they were only preliminaries and moderate, the peak in zinc was phenomenally high and was the culmination of the movement in this metal. This was for the reason that there was an acute shortage in zinc, owing to deficient smelting capacity, and the price for the metal had to go to heights that would induce adventurers to take the risk of providing new plants. An extravagantly high price in these circumstances does not indicate inflation so much as it does an addition to the capitalization of the industry.

The course of zinc throughout the war period has been a perfect reflection of the unimpeded operation of the law of supply and demand. The movement in this market has been absolutely true to form. First, because of shortage in supply, there is a rise to a high figure, which stimulates new production. Then there is the natural decline, in which speculative operations, discounting the inevitable effect of a surplus production, play an important part. As is generally the case, the first anticipating of future conditions is premature, the decline is overdone, and there follows a secondary rise. Then follows the secondary decline, which goes to a lower level than the first one. From this there is a rebound in a tertiary advance, which is less violent than the second. The market gradually loses its resiliency. The rebounds become more and more feeble. Finally, the accumulation of unsold stocks of metal becomes burdensome, and the market settles down to the dead level of the new economic conditions. Trading becomes dull and uninteresting. There is no longer any opportunity for speculative operations. The industry awaits passively the development of some new factors that will start another major movement.

Let alone, the price course of every commodity conforms to this type. The statements that the law of supply and demand does not work under such conditions as this war has created, or that it does not work quickly enough, are manifestly fallacious. What could have been quicker than its working in the case of zinc (which is not an isolated case, for the records of antimony, tungsten, quicksilver, sulphuric acid, and many other commodities are similar)? In certain cases the records of the commodities do not precisely reflect actual conditions. Thus, the graph for copper on the accompanying chart is too high, especially subsequent to the beginning of 1916. This is for the reason that the subtraction of huge blocks in a few transactions in 1916 contracted the volume of business in the major market to about one-fifth the normal, and the frantic bidding for the diminished supply elevated the price to figures far above those for which the bulk of the copper had been sold. Making all due allowance for this, it is evident that the price for copper had probably attained its natural culmination about the end of 1916; for the excessively high prices created by the very conditions above mentioned were operating to curtail consumption, while at the same time production was being enormously stimulated.

There is no doubt whatever respecting the natural culmination in the price for lead about the middle of 1917. Here again we had an unbalancing of the market, similar to what had previously occurred in copper, by reason of the Government taking out of the market a large part of the supply by private agreement, combined with the fear that it was going to take more than it really did. There is a strong indication, moreover, that the price for pig iron had culminated at about the same time as lead. Since the middle of 1917 we have seen an arbitrary disturbance of the conditions in copper and iron by Governmental interference, which has been followed in each case by diminished production.

The great, freely acting commodity—cotton—has continued to rise, and at the end of 1917 stood at the highest point. In comparing the prices for cotton and wheat with those for the metals it should be borne in mind that the metals are produced with regularity, independently of the weather, while the crops of foodstuffs and clothing stuffs are seasonal. The peak in the price for wheat just previous to the middle of 1917 was the result of the foreign governments bidding against each other in a narrow market. With the American Government eliminating this competition and assuming the role of sole buyer, the artificial bulge was smoothed down and the price was stabilized, but at a level higher than had prevailed previous to the second quarter of 1917. The price for pig iron also was fixed at about the same level as in the first quarter of 1917, but that for copper was reduced to a lower figure than had ruled since early in 1916.

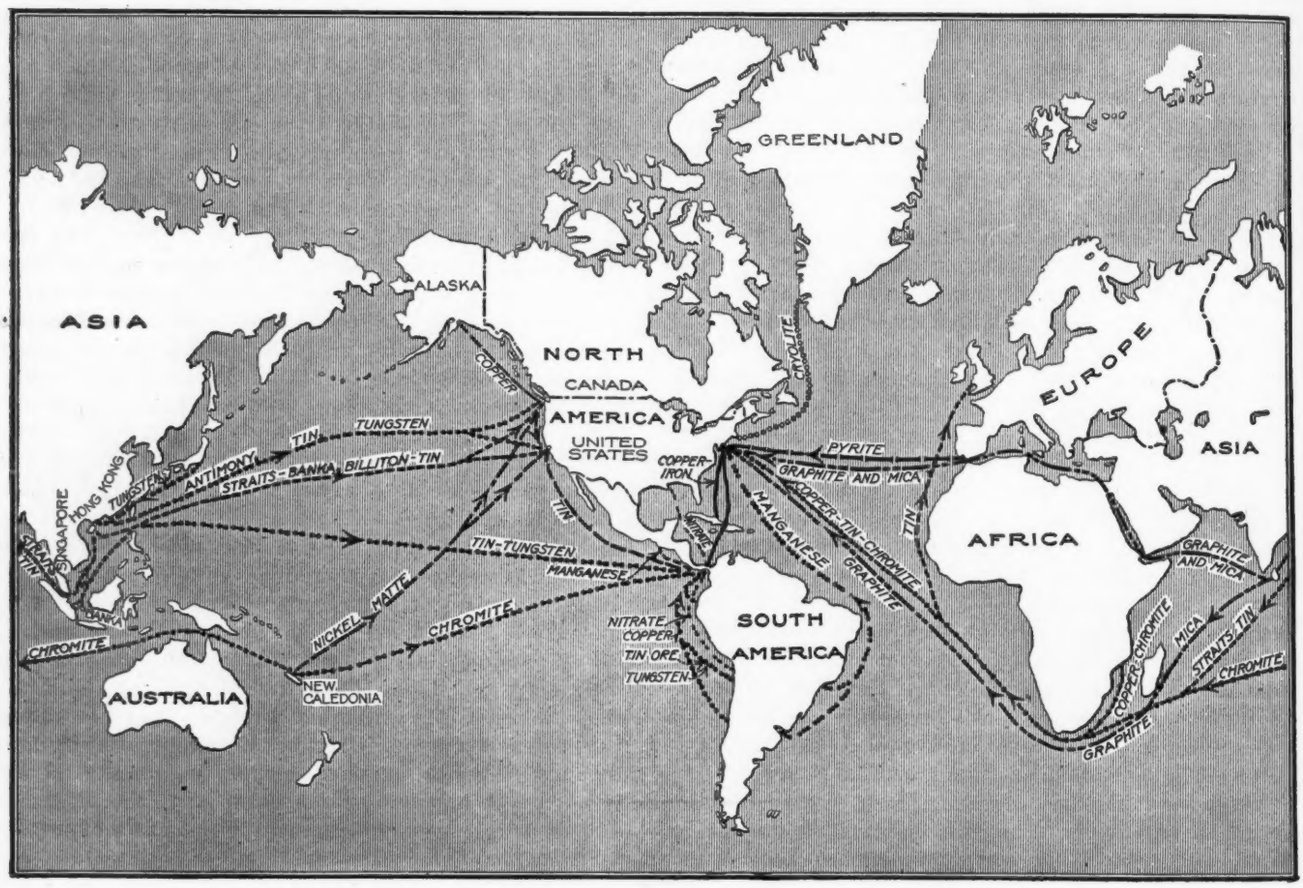
It is to be regretted that there are not more data for labor. The rate of wages paid by the U. S. Steel Corporation is typical of the record of any single industry. The rate is maintained for a longer or shorter period, and the changes are abrupt. Therefore the graph is like a series of steps. Nevertheless, the general parallelism between this graph and that for the price of pig iron is very striking. Only in the middle of 1917 does the space between the lines contract narrowly, and for that there is a specific explanation, viz., the price for pig iron at this time represented the sale of an unusually small part of the production.

In the graph for wages in the State of New York all industries are summarized, and this line therefore exhibits naturally the characteristics of a series of index numbers. Comparing this with Bradstreet's index number, it is immediately manifest that both have risen in substantially the same proportion, but in 1917 wages for a brief period lagged behind. There must not be too close comparisons of these graphs, however, for it is well known that a commodity index number and the cost of living are two different things. The committee of economists of the U. S. Treasury has already pointed out that the wholesale prices for commodities have risen since 1914 at a materially higher rate than retail prices, while even data of retail prices do not exactly reflect the cost of living, for they do not include rents, the use of public services, and other costs that have notoriously risen but little, or even none at all. There can hardly be any doubt that the *average* rate of wages in the State of New York, which has

risen about as fast as the *average* of wholesale commodity prices, has risen a good deal more in proportion than the *average* cost of living.

Mineral and Metal Imports Into the United States

A FEW weeks ago Secretary Lane published a chart showing the lines and kinds of minerals and metal imports into the United States, which was so inaccurate, both for sins of omission and commission, that we have prepared the same kind of a chart that is more nearly correct. Even so, fault may still be found with our chart, the draftsman having neglected, for example, to show the movement of iron ore from Chile to Baltimore, and of manganese ore from India to the United States and from Cuba to the United States.



IMPORTS OF MINERALS AND METALS INTO THE UNITED STATES

With changes so kaleidoscopic as those of the present, movements of ocean-borne traffic change radically from year to year. Thus, imports of zinc ore into the United States from Australia and Spain ceased in 1917, for the reason that the rise in freight rates no longer permitted them. A considerable tonnage of zinc ore was carried in 1917 from China to San Francisco, and thence overland to the smelters, but that movement also has ceased.

Ferromanganese is no longer brought from Europe to the United States. On the contrary, Europe wants to obtain it from us. We still get some tin from Singapore via British ports, but to a more and more extent our tin importations are coming directly from Singapore, Banka, etc. In the main, this movement of tin, and similarly of antimony and tungsten, is in ships going to Vancouver and San Francisco. From those ports the commodities are either carried overland or else are taken in ships steaming down the coast and passing through the Panama Canal. However, there is some tin, especially from Banka, and other Eastern products that are carried in ships traveling directly from the Far East to the Panama Canal. From New Caledonia chromite comes to this country both via the Panama Canal and via Cape of Good Hope, but the only smelter who is obtaining nickel matte from that quarter brings it into Pacific ports and thence overland.

The considerable importation of copper, copper matte, etc., from South Africa comes directly to Atlantic ports. Some products of the Far East, such as graphite and mica, come to New York, both via Suez and via the Cape of Good Hope.

The largest tonnage of imported minerals coming into the United States consists of pyrites, manganese ore, and nitrate of soda. Among the metals, copper, tin and antimony stand in about the order mentioned.

The Journal Index

THE Index for Vol. 104, Part II, of the *Engineering and Mining Journal*, will be mailed with this issue. Any subscriber not receiving a copy of same should notify the subscription department at once.

The Proposed Mines Administration

THE bill proposed by the War Minerals Committee, which excited so much opposition in the West, has been revised so as to exclude the major minerals and metals, such as iron, copper, zinc, lead, etc., and is now written so as to include "all ores, minerals, intermediate metallurgical products, metals, alloys, and chemical compounds of antimony, arsenic, bismuth, bromine, chromium, corundum, emery, graphite, irridium, magnesite, manganese, mercury, mica, molybdenum, osmium, platinum, potash, pyrites, sulphur, tin, tungsten, uranium, vanadium, and of other rare or unusual elements the supply of which may, in the judgment of the President, be inadequate for war and industrial needs."

We are opposed to the bill in its present form, or in any form that is going to authorize Governmental interference with our industries. That it is necessary to confer upon the President, as commander-in-chief, any authority of this sort beyond what he possesses already, we cannot believe. The Government has already commandeered tin and platinum, and it can commandeer anything else it wants to. It is unnecessary to pay attention to any farrago about monopolization, hoarding, injurious speculations, manipulation, and private control affecting supply, distribution and movement.

The main purpose of the bill, we understand, is to increase the supplies of manganese ore, pyrites, and a few other minerals whereof we are temporarily short.

The supply of these minerals is already being increased immensely and rapidly under the influence of high prices, which is freely admitted by the promoters of the bill.

"But," they say, "there are deposits of these minerals that are too risky to interest private adventurers, or deposits that cannot be worked profitably except with a guarantee of high prices for a sufficiently long period."

Very well, then, let Congress create a United States mining corporation, with any capital that the promoters of this legislation see fit to recommend, and let that corporation operate such mines. Let such a corporation risk the public money, if it must be done, in a regular business way.

"Oh, no," answer the advocates; "we could never get such legislation through Congress. You know, there is a strong aversion in the popular mind to the very name of corporation."

We might argue that such aversion is stupid. We might argue further that if it were admitted that all corporations are bad it would also have to be admitted that a large proportion of them are smart, and that the Government might well employ the corporation system on the theory of setting a thief to catch a thief. We might further point out that Congress saw fit to create the U. S. Emergency Fleet Corporation, the U. S. Wheat Corporation, etc. Dismissing all that, we suggest that if such legislation cannot be obtained, the War Minerals Committee should ask Congress to appropriate to it the sum of $5,000,000 (or such other sum as it deems proper) with which to obtain manganese ore and pyrites in any ways that it may see fit to employ. This would be far better than leading the whole mining industry into the dangers that we think are lurking in the proposed bill.

BY THE WAY

The Bureau of Labor statistics calculates that the present army ration costs 33.25c. a day and the navy ration 43.81c., compared with 27.99c. and 37.65c., respectively, in 1916.

The Petrograd *Dyen* thus describes parliamentary etiquette as practised by the Bolsheviki in a meeting of the central Soviet: "The hall resounds with profane expletives. The chairman, a trusted lieutenant of Trotzky, replies to an attack by a critical member, who makes an unsavory insinuation with regard to Bolshevist policy. Somebody calls Trotzky a 'blackguard.' The Bolshevists jump up from their seats, cut to the quick by such an act of lese majesty; they make for the offender and threaten to lynch him. The air is heavy with angry shouts, piercing whistles, and market-place expletives. Trotzky leaps to the tribune and urges his followers to further violence. The chairman, after vainly endeavoring to be heard, at last leaves the chair, abandoning the meeting to general pandemonium."

Mining engineers who have occasion to travel in Central America may be interested to know that the U. S. *Commerce Reports* heralds the fact that a new hotel is being built in Tegucigalpa, the capital of Honduras, and that among its "palatial fittings" special mention is made of four porcelain bathtubs. We refuse to get excited over this. We are not desk lizards all the time, and once in a while we have some of the palatial bathtubs exhibited to us by Don Jaime or José, the *camarero*, when we arrive at the Gran Hotel de Chinchas or the Mesón Centrál, as the case may be. We have also experienced the exalted state of mind induced by circumstances like the following: You arrive at the hostelry, arrange for mules, leave excess baggage and hit the trail for the mountains. After a week or 10 days of strenuous work, conducive to profuse perspiration, you are returning by a slightly different route. About 3 p.m. you come to a dandy river and suggest to Harry that a swim would be about all right. Harry says, "We hardly have time for that, Bill. Just consider how much better it will be to get into one of those dandy tubs with a chunk of soap and then dress for dinner like white men." "Sure thing," you say, reluctantly gazing back. At the hotel you rush to your room, toss leggings, spurs, khaki and B. V. D.s in a confused heap in the corner and then race down the tiled hall to those palatial tubs. A trickle of water enables you to work up a good lather as a starter and then the pipes refuse to yield another drop. After five or 10 minutes' expectant hesitation, you clap your hands and yell for José, demanding water. "Ah, señor," he says apologetically, "but thees is Thursday and the band she is playing by the Plaza." "What's that got to do with it, *que va?*" you retort angrily, as the soapsuds begin to dry and cause discomfort. In innocent surprise José says, "But did you not know that by the orders of the Señor Alcalde all the water supply must be shut off on band nights so there will be enough for the big fountain?"

Personals

Have you contributed to the Association of the 27th Engineers?

F. R. Weekes has returned to New York from a trip to Cuba on professional business.

Charles Wright has succeeded **William J. Uren** as manager of the Keweenaw Copper Co., at Mandan, Michigan.

H. H. Nicholson will be inspecting copper properties in Southwest Nevada after Mar. 10, with headquarters at Luning.

Carl A. Lewis, until recently superintendent of the Candida copper property of ex-President Gomez in the Province of Piñar del Rio, Cuba, is at Wollaston, Massachusetts.

S. R. Elliott, assistant to M. M. Duncan, of the Cleveland-Cliffs Iron Co., formerly of Ishpeming, Mich., is major of the 28th Engineers, the special quarry regiment now being formed.

H. A. Robinson, of the Genoa mine of the Oliver Iron Mining Co., has been made chief engineer of the newly formed Fayal-Eveleth district of the company. **E. Dodd,** of Mesabe, is assistant.

Lee Wilcox has been made superintendent of the Gogebic Range mines of the Republic Iron and Steel Co., with headquarters at Ironwood. **E. W. Butcher,** of Gilbert, Minn., succeeds him as chief engineer for the company at Duluth.

Rukard Hurd, secretary of the Minnesota Tax Commission for many years, is director of the Bureau of Statistics and Reports at the General Engineer Depot at Washington. He has been commissioned a major in the Engineer Officers' Reserve Corps.

O. E. Whiteside, who was elected one of the vice presidents of the Canadian Mining Institute at its Montreal convention on Mar. 6-8, tendered his resignation on the ground that the West was sufficiently represented in the council. **Balmer Neilly,** of Cobalt, Ont., was elected in his place.

Dr. F. A. Fahrenwald, consulting mining engineer and metallurgist, of Cleveland, Ohio, will be in the West on professional business from about Mar. 25 to May 10; the first two weeks in New Mexico and Arizona; the following two in California and Nevada, and the remainder of the period in the Northwest.

J. Leonard Replogle has resigned as chairman and director of the Wharton Steel Co. to devote his time more fully to his work as chief adviser to Government agents purchasing steel and iron products. He is succeeded as director by **Charles B. Ellis. John E. Perry** has resigned as president of the company, being succeeded by **W. H. Brevoort,** a Western pig-iron manufacturer. **J. H. Hillman, Jr.,** of Pittsburgh, was also elected a director.

Obituary

C. C. Belding, a pioneer and well-known mining man of California, died at Oroville on Feb. 21. He was 85 years old, born in New York and went to California in 1851, where he engaged in mining at Sutter Creek, Amador County.

Charles C. Duffield, said to have compiled the first oil report ever published, died in Cleveland, Ohio, Mar. 8, aged 80 years. He is said to have obtained the figures for the report, which was published in 1860, by means of a canoe trip up the Alleghany River and Oil Creek.

James Drummond McGregor, vice president and director of the Nova Scotia Steel and Coal Co., died at his home in New Glasgow, N. S., on Mar. 4, aged 80 years. He was one of the incorporators of the company. Mr. McGregor was active in politics and was elected to the Canadian Senate in 1903. He became Lieutenant Governor of the province of Nova Scotia in 1910, in which capacity he served for five years.

Societies

American Institute of Chemical Engineers will hold its summer meeting in Berlin, N. H., June 19-22. Headquarters will be at Mount Madison House, Gorham, New Hampshire.

Illuminating Engineering Society, New York Section, met on Mar. 14, in the United Engineering Society Bldg., New York. A paper entitled "An Aspect of Light, Shade and Color in Modern Warfare" was presented by M. Luckiesh.

American Association of Engineers will hold its fourth annual convention in Chicago on May 14. The growth of the association makes it necessary to amend the by-laws. National officers and directors are to be elected for one ensuing year. Edmund T. Perkins is the retiring president.

Colorado Scientific Society held its 332nd regular meeting on Mar. 9, at the Shirley Hotel, Denver. The speaker of the occasion was H. E. Hilts, general manager of the Portland Cement Association of Chicago. His subject was "The Construction and Use of Concrete Ships." The lecture was illustrated by lantern slides.

Montana Society of Engineers held its monthly meeting at the Silverbow Courthouse at Butte, Mont., on Mar. 11. The program for the annual meeting to be held in Butte in April was announced, as well as the following names of officers to be elected at that meeting: For president, Willis T. Burns; first vice president, Samuel Barker, Jr.; second vice president, Charles A. Lemmon; secretary, Clinton H. Moore; treasurer, Harry H. Cochrane; trustee for three years, Frank A. Linforth. Papers were read by Samuel Barker, Jr., on the manganese deposits at Philipsburg, Mont., and by Wallace N. Tanner, on the construction work of the Anaconda Copper Mining Co. in Anaconda and Great Falls during the last year.

Institute of Metals held its annual general meeting on Mar. 13-14 in the rooms of the Chemical Society in London. At the session on Mar. 13, the president, Sir George Beilby, inducted into the chair the president designate, Prof. H. C. H. Carpenter. The following papers were submitted to the meeting: "The Relationship Between Hardness and Constitution in the Copper Rich Aluminium-Copper Alloys," by J. Neill Greenwood, Manchester; "Aluminum Bronze Die Casting," by H. Whitaker, Manchester, and H. Rix, Manchester; "On Grain Size," by G. H. Gulliver, London; "Lead-Tin-Antimony Alloys," by Owen W. Ellis, London; and "An Investigation on Unsound Castings of Admiralty Bronze (88·10:2): Its Cause and the Remedy," by Prof. H. C. H. Carpenter, London, and Miss C. F. Elam, London.

Canadian Mining Institute—At the annual banquet held at the Windsor Hotel, Montreal, on Mar. 8, at the close of the annual convention, the principal speaker was Hon. Martin Burrell, Secretary of State and Minister of Mines, who stated that it was not the intention of the government to introduce any new mining act during the present session. He believed the Hudson Bay Ry. would be of great value from a mineralogical point of view, rendering a vast hinterland accessible for exploration, and expressed himself as firmly convinced that something should be done to put the peat industry on an economic basis and make available 120,000,000 tons of material as a valuable subsidiary fuel. Bradley Stoughton, secretary of the American Institute of Mining Engineers, spoke of the part taken by the engineers of the United States in war work. W. W. Vaughan, president of the Canadian Society of Civil Engineers, congratulated the institute on the formation of an iron and steel section. D. A. Macdougall, president of the Mining Society of Nova Scotia, spoke in favor of the affiliation of that body with the Canadian Mining Institute.

American Association of Petroleum Geologists was formed at a meeting of petroleum geologists held in Oklahoma, Okla., on Feb. 15-16. The new society is an outgrowth of the Southwestern Association of Petroleum Geologists, which has been in existence for the last three years. Over 100 geologists were present. The following officers were elected: President, Alexander Deussen, Houston, Tex.; vice president, Dr. I. C. White, Morgantown, W. Va.; secretary-treasurer, W. E. Wrather, Wichita Falls, Tex.; and editor, Charles H. Taylor, Oklahoma, Okla. Addresses were made by Thomas M. O'Donnell, representing the U. S. Fuel Administration; Prof. James F. Kemp and Dr. I. C. White. The papers presented at the various technical sessions included the following: "The Distribution of Underground Salt Water and Its Relation to the Accumulation of Oil and Gas," by Roswell H. Johnson, Pittsburgh, Penn.; "The Oil Fields of Cuba," by E. L. De Golyer, New York; "The Relations of Former Shore Lines to Oil Accumulation," by A. W. McCoy, Bartlesville, Okla.; "The Bend Formation as a Source of Oil in Northwest Texas," by W. E. Wrather, Wichita Falls, Tex.; "Contributions to the Stratigraphy of the Red Beds," by D. W. O'Hern, Oklahoma, Okla. Papers were read covering points of geologic interest brought out by development in the various fields in 1917 as follows: The Gulf Coast, by Alexander Deussen, Houston, Tex.; Kansas, by R. L. Moore, Lawrence, Kan.; Kentucky, by J. W. Pemberton, Tulsa, Okla.; Northwest Louisiana, by Mowry Bates, Tulsa, Okla. The next meeting will be held in Houston, Texas.

Industrial News

American Zinc Products Co. has announced the removal of its general and sales offices from Warren, Ohio, to Greencastle, Indiana.

Easton Car and Construction Co., Easton, Penn., announces the opening of a branch office in Washington, D. C., at 225 Kellogg Bldg., 1422 F Street, N. W.

Walter A. Zelnicker Supply Co. has recently secured the services of G. W. Bichlmeir, previously with the supply departments of the Missouri Pacific and Kansas City Southern railway companies. Mr. Bichlmeir is in the Zelnicker machinery department.

Huff Electrostatic Separator Co., owner and manufacturer of the electrostatic process of ore concentration, has opened an office at 120 Broadway, New York, for consultation regarding ore-dressing problems, especially the dry concentration of ores and the separation of valuable minerals from others which are commercially detrimental.

Dingle-Clark Co. has been organized, with offices in Engineers Bldg., Cleveland, Ohio. It will handle motors, transformers, controllers and turbo gears and will install electrical equipment for any size plant. Howard Dingle and W. W. Clark were, up to Feb. 1, district manager and assistant manager, respectively, of the Crocker-Wheeler Co. in Cleveland.

William T. Price has resigned as manager and chief engineer of the oil engine department of the De La Vergne Machine Co., to become president of the P-R Engine Co., of New York, and second vice president of the Rathbun-Jones Engineering Co., of Toledo, Ohio, which will undertake the sale and manu acture respectively of Price-Rathbun stationary and marine oil engines.

Ridgway Engine and Dynamo Co., Ridgway, Penn., is building what is claimed to be the largest turboblower of its type in the world for the Canadian Copper Co. It is to supply air to six large Peirce-Smith converters at the company's Copper Cliff works in Ontario. The eight-stage blower will be completed in about six weeks and is designed to deliver 52,000 cu.ft. of air at 13-lb. pressure. It will be direct connected to a 2650-hp. synchronous motor running at 1500 r.p.m.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Aluminum, Process of Metal-Plating. William Joseph Travers, Buffalo, N. Y. (U. S. No. 1,256,954; Feb. 19, 1918.)

Concentration — Apparatus for Saving Gold and Other Precious Metals. William D. M. Howard, San Francisco, Calif., assignor to Harry De Courcy Richards, San Francisco, Calif. (U. S. No. 1,257,487; Feb. 26, 1918.)

Copper—Treatment for Various Purposes. William Thompson Howard, Baltimore, Md., assignor to Lucy Virginia Howard, Baltimore Md. (U. S. No. 1,257,943; Feb. 26, 1918.)

Flotation—Ore Concentration Process. Benjamin H. Dosenbach, Butte, Mont. (U. S. No. 1,257,329; Feb. 26, 1918.)

Metallurgy — Process of Extracting Precious Metals from Ores Containing Alkaline Earth Carbonates, etc. John G. Kirchen and Donald B. Bradner, Tonopah, Nev. (U. S. No. 1,257,612; Feb. 26, 1918.)

Sulphuric Acid. Concentrating. John W. Leitch, Huddersfield, England. (U. S. No. 1,257,894; Feb. 26, 1918.)

Sulphuric Acid — Method of Concentrating. John Walker Leitch, Huddersfield, England. (U. S. No. 1,257,895; Feb. 26, 1918.)

Editorial Correspondence

SAN FRANCISCO—Mar. 15

Revised Oil Field Maps are being prepared by the oil and gas department of the State Mining Bureau, under the direction of R. P. McLaughlin, oil and gas supervisor. In the last two years many important additions have been made to various areas of proved oil land, and the new maps will prove useful. The maps will be in the form of blue-line prints, and a remarkably low selling price will merely cover the cost of blueprinting. Maps of the Santa Maria field have already been completed, and may be obtained at the San Francisco, Los Angeles and Santa Maria offices of the State Mining Bureau. The map is on a scale of 2000 ft. to one inch and is made in two sheets each 34 x 37 in. The price of each sheet is 50c. The eastern sheet includes Cat Canyon and Los Alamos, while the western sheet includes the old Santa Maria field, Casmalia and Lompoc. A map of the Sargent field, in Santa Clara County, on a scale of 2000 ft. to one inch, has been completed and is on sale for 25c. The map is 15 x 15 inches.

Grass Valley Mining District is at present reported prosperous despite the high cost of materials and labor. About 1000 men are employed by the several mining companies. The North Star and Empire companies are the leading producers, distributing substantial dividends and employing approximately 400 men each. While wages are high, there is no lack of skilled labor, and transportation facilities are good, there being direct railroad connection with the main line of the Southern Pacific Railroad at Colfax. In addition to gold, indications point to large production of chrome from points tributary to Grass Valley and Nevada City during the coming summer. Most of the chrome deposits are in the higher elevations not easily accessible on account of snow in the midwinter. Grass Valley district also produces tungsten, in the Union Hill mine. Recently there have been a number of old properties optioned and reopened, with prospects of being again placed in the producing class.

The Price of Crude Oil at the wells in California fields increased during the first half of 1917 from 73c. to 98c. per bbl. The cost of production both for labor and material also increased during the year. The State Mining Bureau holds that, contrary to common opinion, the business of producing oil has not in past years returned average profits commensurate with the risk involved. In view of unusual war conditions, the bureau states that a prophecy as to future prices would be hazardous. However, it claims it would be difficult to advance reasons why the prices should be expected to fall. Reviewing the operations of the year, the outstanding features are active field development coupled with an alarming decline in storage. The daily production amounted to only 90% of the consumption. The consumption during the last year was the greatest on record, being about 12,000 bbl. per day greater than 1916. In that year the current production supplied less than 90% of consumption. The increased consumption reflects the general activity of the Pacific Coast region. Under normal conditions, such increased consumption would be welcome, but the problem now confronting the oil industry is to supply the other dependent industries with power. There was a large addition to the proved acreage of oil-producing land in 1917 by the development of the Montebello field, near Los Angeles, which now amounts to 800 to 1000 acres. The original discovery was made by the Spaniards, and since then a number of companies large and small have entered the field. Several of the wells are flowing at the rate of 1000 bbl. per day.

Standard Oil Co. of California has issued statement of operations and results in 1917 showing net profits for the year, after deductions for depreciation, depletion and Federal taxes, of $18,649,630. This is equivalent to about $18.75 per share on outstanding capital stock at par. Net profits for the year amount to about 16½% of capital and surplus as of Dec. 31, 1917. Earnings for the year, after deduction of all operating and minor expenses, netted $30,377,073. From this there was redeemed over $3,620,494 for depreciation and $2,276,831 for depletion and deducted for extended Government income and exess-profit taxes. During the year cash dividends were distributed at the rate of 10% per annum on the issued capital stock of the company, amounting to $9,316,248. In addition a stock dividend of 33⅓% was paid in April, 1917, amounting to $24,843,328. The inventories, reporting principally oils in stock secured in actual cost, amounted to $26,799,564. The company drilled and completed 120 wells in the year and added to its holdings by purchase and lease 1395 acres of developed property, which at time of purchase were producing about 2000 bbl. per day and since increased to 3000 bbl. per day. "Wildcatting" has resulted in some failures and some successes. A most notable and successful "wildcatting" venture was in the Merced Hills seven miles east of Los Angeles, now producing 10,700 bbl. per day from seven finished wells. The increased plants at Richmond, El Segundo and Bakersfield during the year cost $3,276,221. The company added to its sailing fleet the "John Ena," having carrying capacity of 105,000 cases; the "La Merced," 38,000 cases, and several smaller boats for towing and barging. The steamship "Col. E. Drake" was tendered to the Federal Government in May, 1917, and is now in Government service. Regarding production and sales, the report states that the gross production from the company's wells in 1917 was 18,286,588 bbl. of crude oil, as against 14,777,124 bbl. in 1916, a gain of 3,509,464 bbl., or a daily average gain of 9720 bbl., equivalent to an increase of 23.74%. Standard Oil Co. crude oil stocks and equivalent as of Dec. 31, 1917, were 15,101,696 bbl.; on Dec. 31, 1916, 22,753,178 bbl., or a total decrease in the company's stocks of 7,651,482 bbl. The total value of all sales of all products, both foreign and domestic, for the year 1917 shows an increase of 42.45% over 1916. The export business of the company for 1917 showed little change from that of 1916.

DENVER—Mar. 14

War Excess-Profits Tax is receiving serious attention by a committee appointed at the conference meeting of Western mining states to confer with the Treasury Department at Washington. This committee, which has been in Washington during the last month, has prepared an amendment to the present law, to take effect next year, which will remedy some of its defects as applied to the mining industry. Regulations for the administration of the law this year have been issued by the Department.

A Decision of Interest to Mining Men of Colorado was made early this month by Judge Perry, of the district court of Denver, in which he held that an insurance claim sustained by the State Industrial Commision must be paid immediately and cannot be stayed by the beginning of litigation. The 5 per cent advance in the rates for compensation insurance announced by old-line companies the first of the year makes a difference of between 25 and 40 per cent in the rates demanded by these carriers and the state fund.

Silver Producers of Colorado are interested in any movement toward fixing the price of silver at a figure that will encourage production and safeguard their interests. A committee representing Colorado and other western interests has held several conferences recently in Washington, and has been joined by a representative from Great Britain, who was sent to this country to confer with proper Government authorities regarding an international agreement whereby the price of silver will be fixed at a figure which will encourage production without disturbing the complex financial relations existing between the Allied countries.

The Mineral Land Leasing Bill, which is of special interest to mining men of Colorado and Wyoming, has received considerable attention during the last month by the House Public Lands Committee at Washington. Members of the oil section of the Colorado chapter of the American Mining Congress were in attendance at these meetings, urging such amendments to the Walsh-Pittman bill as would safeguard the interests of western oil men. Congressman Taylor advised the organization that the Department of the Interior is not disposed to permit the exemption of oil-shale lands from the general provisions of the mineral lands leasing bill and that the department will hold that title to these lands cannot pass under present placer laws. A meeting of representatives of the oil-shale men of Denver and the western slope has been held in Denver to consider the situation, and a representative has been sent to Washington to confer with the department and Bureau of Mines, for the purpose of reaching, if possible, an agreement whereby the embargo on the development of oil-shale lands could be raised. It is probable that oil and shale interests will come to an agreement with the Department of the Interior, whereby no restrictive legislation affecting legitimate operation will be enacted, and, on the other hand, every encouragement will be extended by the Government to increase production or hasten the development of the oil resources of the country.

SALT LAKE CITY—Mar. 13

The Salt Lake, Filmore & Kenosh R.R., proposed, promises more rapid development for the western end of the Tintic mining section, which at present is without outlet by rail. Four or five properties are being worked in this section, and some development has been done, although no deep work has been attempted. The Deseret Mountain is developing copper ore. Other properties are the Scotia, Eighty-eight, Lucky Shepherd, Tintic Delaware, Utah Zinc, etc., and ore is sent out from the district from time to time. The railroad, which has good backing, will start from the Salt Lake route at Lynndyl, in the central part of the state, going south for 50 miles by way of Holden, Filmore and Meadow. A 25-mile branch from Lynndyl, also going northwest, will include the west Tintic mining section. Articles of incorporation have been filed, with the capitalization placed at $500,000, with shares of a par value of $100, all of which have been subscribed. G. W. Craig, connected with the Salt Lake route at Provo, will be president, F. D. Kimbal vice president, and Alva Nelson treasurer, the two latter also of Provo. W. S. McCormick, of this city, is among the directors. Work on the new railroad is expected to start in May.

BUTTE, MONT.—Mar. 13

The Butte Metal Trades Council has reported through the grievance committee a satisfactory settlement of the controversy over certain men employed by the Anaconda and Butte and Superior companies, and the report has been accepted. While this decision has cleared the atmosphere from a threatened strike for the time being, the walk-out of the electricians at Great Falls, which largely affects the Montana Power Co., causes some anxiety in the Butte camp, in view of the possibility of cutting off power at the mines. It has also been rumored that an effort will be made by the Great Falls council to enlist the help of the Butte metal trades in the demands of the Great Falls men. The electricians' walkout occurred in sympathy with the striking machinists, who demand an increase of $2.25 a day, which has so far been denied by the Great Falls Employers' Association.

Anaconda Company Experiments are being conducted on a large scale at the Ophir mill of the Butte-Detroit company, in Butte, with a view to develop a satisfactory method for concentrating the large masses of pink manganese ore or rhodocrosite that occur in the company's Ophir mine and in many other mines of the Butte district. Rhodocrosite contains from 20 to 30% manganese. Under the direction of Carl Trauerman, the company's metallurgist, from 75 to 100 tons of pink manganese ore are now being treated per day at the Ophir mill, and a concentrate containing 36% manganese and 10% silica has been obtained from an ore assaying 23% manganese and 40% silica, the ratio of concentration

being about 2½ to 1. In addition to the manganese concentrates, a gold-silver-iron product has been made, the value of which has been said to pay for the entire milling cost. Jigs and Wilfley tables are the principal concentrators. The cost of milling per ton at present is reported to be about $1 and the extraction around 55% of the manganese in the raw ore.

WALLACE, IDAHO—Mar. 14

The Northwest Mining Association, at its recent meeting in Spokane, adopted a resolution advocating Government control or ownership of the smelting business, hoping thereby to secure lower rates on treatment charges than those offered by the smelting companies at present. Although this resolution purports to represent the sentiment of the mining industry of the Northwest on this much mooted question, as a matter of fact the pronouncement has received a cold reception from the substantial producers of the Northwest. All are agreed on the need for some remedy, but that proposed at the Spokane meeting is not acceptable to the ore producers. A plan has already been outlined to build a smelting plant and refinery at some point on Lake Cœur d'Alene, to be owned exclusively by ore producers of the northwestern states and British Columbia. According to this plan, the producers would get their ore treated at cost.

LEAD, S. D.—Mar. 12

The Annual Report of the Homestake company shows earnings for 1917 amounting to $2,400,000 and of this sum $1,959,048 was paid as dividends. There was treated 1,677,623 tons of ore, realizing an average of $3.94 per ton. Among the disbursements are included the following: Spearfish Hydro-electric plant No. 2, $446,000; property purchase, $15,400; pensions, $7166; insurance, $21,757; taxes, $303,595, and hospital $54,187. The mine account showed a total disbursement of $2,226,000, and this included the following items: Mine labor, $1,485,000; machinery, $287,000; powder, $292,000; timber, $86,000. During the year, 11,075 ft. of development drifts and 2349 ft. of raises were driven. In addition, 5896 ft. of prospecting drifts were completed. The total broken ore in the mine at the first of the year was 1,919,177 tons, and there remains blocked out and readily accessible profitable ore sufficient for many years.

HOUGHTON, MICH.—Mar. 14

The Seneca Copper Corporation's shaft has no expectation of striking the Kearsarge formation before attaining a depth of 2100 ft. Progress should be at the rate of 150 ft. per month, so that the shaft should reach the formation by July, 1919. In addition to striking the Osceola amygdaloid and the Osceola conglomerate, the Seneca will likewise cut the Calumet conglomerate. But this formation would have to be richer on the Seneca than it is on the Ahmeek to be of any interest. The Kearsarge lode is expected to contain a good grade of copper. Shaft sinking through barren ground in the Lake Superior district has many difficulties, and the Seneca has been almost a year in getting started and in sinking 100 ft. When the formation is reached there will be no immediate call for a stamp mill, as the lode will have to be opened. This can be accomplished at first in the short laterals, as the shaft strikes the corner of the 40 line. The laterals will appear as sinking progresses. The longest lateral from North Ahmeek is over 1000 ft. from the Seneca line, but has a grade of 19 lb. copper per ton. W. J. Uren, superintendent, has a shaft-sinking and skip-handling plan that promises to be a revelation when put into operation.

TORONTO—MAR. 12

Eastern British Columbia mining companies are not experiencing any water shortage this year, an unusual condition, and as a result preparations have been made to resume milling at a number of properties. By the close of this month virtually every plant near Slocan Lake will be in operation.

Electrical Smelting of Scrap Steel to make billets for shells is to be accomplished by the power plant at the Cordova gold mines, near Deloro. P. Kirkgaard, manager, has been in Washington arranging for the project with the War Board, as the product will be utilized for an American contract, now under way in Canada. The electrical equipment will be made and designed by Frederick N. Snyder, of Chicago. The Cordova deposit is low-grade gold, and production will not be resumed until after the war. The electrical installation may also be used for making ferroalloys.

Water Discovery in Southern Alberta is credited to the Geological Survey of Canada. A large area of Southern Alberta, lying between the South Saskatchewan River and the international boundary, has been known as the "dry belt," as agricultural development has been handicapped by lack of water. After an inspection of the area the Geological Survey officials decided that flowing water should be available in at least one million acres of this district. Three test wells were sunk, in two of which water was secured. One well sunk to a depth of 500 ft. struck a flow of 4000 gallons per day, and in another at a depth of 602 ft. a flow of 9000 gallons per day was obtained.

The Ontario Government recently received a delegation of operators from the Gowganda district in the matter of the improvement of the road from Elk Lake to Gowganda, a distance of 27 miles, and gave assurance of government assistance for the project. The work will be done this season, and a road suitable for automobiles and motor trucks will be provided to take care of the increasing traffic westward from the terminus of the Elk Lake branch of the Temiskaming & Northern Ontario R.R. Plans for the extension of the railroad will be held in abeyance at least until after the war. The prospect of considerable activity in the district is the occasion for the government's interest in the matter at this time. The only producing mine in the district is the O'Brien-Miller Lake. The discovery of this property last fall promises to be most noteworthy. Ore was discovered at a depth of 350 ft. The mine is owned by M. J. O'Brien, of Renfrew, Ontario, is equipped with a mill, and uses water power from Gowganda Lake.

The Mining News

ALASKA

Alaska Shipments of Copper ore, matte, etc., in February to the United States were 13,116 tons, having a copper content of 6,249,456 lb. and valued at $1,464,206.

ARIZONA

Cochise County

SHATTUCK ARIZONA (Bisbee)—Production in February was: Copper, 854,042 lb.; lead, 66,765 lb.; silver, 6590 oz.; gold, 72.63 oz.

Graham County

INSPIRATION (Miami)—Copper production in February, 6,200,000 lb.

Yavapai County

GREEN MONSTER (Jerome)—Struck a body of low-grade copper ore. Winze now sinking on contact, expectant of increase in grade.

PITTSBURG-JEROME (Jerome)—Existence of a copper and iron-stained quartz vein of uncertain width, but at least 95 ft. long, discovered in 900-ft. level.

ARKANSAS

Independence County

WEAVER DOWDY (Batesville)—First crew started opening pits. J. C. Shepherd, of Rush, Marion County, is operator.

INDEPENDENCE (Batesville) — Installed washing plant at Ball mine and now in operation. Also opening up new pits at Penters Bluff.

EUREKA M. CO. (Batesville)—Operating deposit of manganese disseminated in clay. Making additional installation in washing plant on Polk Bayou. Large pulsating jig will materially increase production and make possible a much closer extraction.

Marion County

DIXIE GIRL (Buffalo)—Lately taken over by Dixie Girl Mining Co. A. C. Barnhart is superintendent.

CALIFORNIA

Alameda County

STANDARD MAGNESITE CO. (Livermore)—Operations resumed after temporary shutdown on account storms. Large force workmen employed rebuilding roads and several motor trucks hauling product to railroad.

Amador County

CENTRAL EUREKA (Jackson)—Deepening shaft 500 ft. from the 3450-ft. point. New oreshoots disclosed on 3400 level. Plan to keep 30 stamps dropping during deepening of shaft, drawing ore from 2500 and 2700 levels.

OLD EUREKA (Sutter Creek)—Shaft down 2200 ft. and being deepened at rate of 17 to 20 ft. per week. Sinking to 3000-ft. point, when drifts and crosscuts are to be driven. Prospecting under way, mostly between the 1700 and 2100 levels.

KEYSTONE (Sutter Creek)—East and west drifts started on 2100 level. East drift to develop extension of important orebody found on upper levels; west drift will facilitate prospecting of slate formation, which has yielded large amounts of good ore in neighboring mines.

Glenn County

CHROME DEPOSIT to be developed nine miles west Newville on north side Heifer Camp Creek. Owned by Oscar Millsap and Vester Keller. About 100 tons ore extracted in development. Property optioned by A. Uldull, who will operate for San Francisco men. To construct two miles of road from mine to Orland County road; ore to be shipped by rail from Orland.

Inyo County

ROUND VALLEY TUNGSTEN CO. (Pine Creek)—Mill construction to start as soon as snow melts. Plant to have two Marcy mills; combined capacity, 150 tons. Electric power to be furnished by Southern Sierras Co.

Kern County

MARICOPA-STRAWN (Maricopa)—Permit for stock issue revoked by Commissioner of Corporations because oil company failed to pay state taxes.

Los Angeles County

TUNNEL PETROLEUM CO. (Los Angeles)—Permit to sell capital stock at 50c. for cash; 400,000 shares to be used in drilling for oil. One well started.

RED STAR PETROLEUM CO. (Los Angeles)—Permit to sell 4000 shares at $100 per share for cash, to be used for drilling and equipment of wells and installation of pipe lines and tanks.

Placer County

CHROME DEPOSIT reported from Auburn located on Christiansen place, in Lone Star district. Ranch is owned by Ivan H. Parker, who has made arrangements with F. W. McNear, of San Francisco, for development. Reported mill to be installed. Outcrop said to be 300 ft. wide; some high-grade ore can be sorted and shipped.

San Bernardino County

TRONA CO. (Trona)—Now producing 2000 tons per month that assays 64% chloride of potassium and 15% anhydrous borax. The Solvay Co. is said to have spent large sums on plant and now producing on basis of 86 to 88% chloride of potassium. It is stated that the Nevada Chemical Co. expects to option 2500 acres, which will warrant installation of plant.

Shasta County

FIRST NATIONAL COPPER CO. (Coram)—Reported that, resulting from operation of Balaklala mine, a dividend of $90,000 was paid Feb. 25. Mine ships 300 tons of selected ore per day to the Mammoth smeltery.

U. S. SMELTING, R. & M. CO. (Mammoth)—Smeltery copper production in February, 1,370,000 lb.

BULLY HILL (Winthrop)—Shipping 100 tons good-grade copper ore to Mammoth smeltery. Installation of flotation plant is contemplated. Particular attention given to the Anchor mine development through Rising Star shaft.

AFTERTHOUGHT (Ingot) — Preparations made to start mine; old crew being assembled; the flotation plant will probably be in operation again by time ore is mined. Roads still in poor condition, but will improve with the dry weather.

SHASTA KING (Coram)—Copper mine owned by Thomas W. Lawson interests and optioned by U. S. Smelting Co. being developed on large scale in new territory with satisfactory results. In consequence, work temporarily discontinued on Sutro group near Kennett.

ARPS (Copper City)—After several weeks' idleness operation resumed and good grade ore being extracted from several points. Shasta Belmont, adjoining, being prepared for more comprehensive development of ore said to run 7% copper. Plans are under way for repairing railroad to Heroult.

Siskiyou County

HYDRAULIC MINING in Siskiyou and Trinity counties is active, and recovery of platinum adding materially to profits attending extraction of gold.

KLAMATH RIVER DREDGING CO. (Yreka)—Operating near Walker; has purchased additional territory and lengthened period of activity. Dredge in operation several years and said to be earning good profits.

Tuolumne County

FIFTH WARD (Cherokee)—This and Uncle Sam properties, owned by Robert Marshall and optioned by J. W. Bates, being put in order for resumption of mining. Property developed by 200-ft. shaft on vein and winze 40 ft. from the face. Vein heavily mineralized and said to carry tellurium and free gold; assays show high grade. Mine easily accessible and ore to be shipped by teams and motor trucks.

Yuba County

MAGONIGAL (Smartsville)—Work on this copper property progressing rapidly. 100 tons ore extracted to be shipped to Utah smelteries. Marysville Transportation Co. has contract for hauling ore in motor trucks to railroad at Marysville. Distance 30 miles and during the dry season roads fairly good.

COLORADO

Boulder County

BLACK PRINCE (Caribou)—Financed largely by small stockholders. Rich strike reported recently.

Lake County

FANNY RAWLINGS (Leadville)—Two high-grade shoots silver ore opened recently. Low-grade ore also being developed. Heavy snows have curtailed shipments.

P. O. S. (Leadville)—Shaft reopened and equipped with steam hoisting plant. Work of reopening old workings under way. Expect to mine manganese and iron-silver ores from old workings.

CLIMAX MOLYBDENUM CO. (Climax)—Completed and put in operation first 250-ton unit of three planned. Crude ore averaging 1% MoS_2 and concentrates, 85% MoS_2. Controlled by American Metal Co., Ltd. J. H. White is manager.

San Miguel County

TELLURIDE CONCENTRATE SHIPMENTS in January were: Black Bear, 22 cars; Smuggler-Union, 49 cars; Liberty Bell, 17 cars; Tomboy, 52 cars; Carruthers Lease, 1 car; total, 141 cars.

Summit County

JUNE BUG (Breckenridge) — High-grade silver ore being mined.

ROBINSON MINE (Frawley)—Lease taken and work of reopening under way. Shipments to begin soon.

WELLINGTON (Breckenridge) — Mine and mill operating steadily. Shipments delayed by snow blockade.

WILSON MILL (Frawley)—Now operated as custom mill. Ores from this district and Leadville treated.

PINGREY MINES CO. (Buffehr)—Development of ore said to average 1% MoO_3 and mill site to be selected in spring. O. A. King is manager.

MOLYBDENUM PRODUCTS CO. (Buffehr)—Completing 250-ton mill and aerial tram, and expects to start production early in April. Ore blocked out said to average 1% MoS_2. W. J. McCarthy is manager.

MOLLY B (Breckenridge)—Taken over by Denver company. New boarding and bunk houses being built, and air-drill equipment to be installed. Ore is copper containing some gold and silver, and lies in blanket formation. Some bismuth also been shipped from this property.

Teller County

CRESSON (Cripple Creek)—Important strike good-grade ore recently on 10th level.

WILD HORSE (Cripple Creek)—Operated by United Gold Mines Co. Shipments begun.

ISABELLA (Cripple Creek)—Lessees on dumps of Lee and Empire shafts making steady production.

GRANITE (Cripple Creek)—Bobtail vein opened recently on 1750 level; shows good grade. This vein is one of best in upper levels of Portland workings.

AMERICAN EAGLE (Cripple Creek)—Worked entirely on split-check system by lessees. Good ground yet available for lease. Owned by Stratton estate.

ROOSEVELT DRAINAGE TUNNEL (Cripple Creek)—Two shifts at work. Main heading toward Golden Cycle shaft and drifting to Portland No. 2 and Cresson shafts.

IDAHO

Shoshone County

HECLA (Wallace)—Shaft down 2000 ft., being 400 ft. below the lowest level. Station is about completed and shaft to be sunk 200 ft. further at once.

REX CONSOLIDATED (Wallace)—Old Rex absorbed by Rex Consolidated Mining Co. Under agreement to sink 700-ft. shaft 300 ft. and explore. Company has 300-ton mill. Raymond Guyer is manager.

YUKON GOLD (Murray)—Installation of second dredge to work the Prichard Creek ground this season out of the question, since no move has been made to restore the railroad washed out two months ago for miles along Prichard Creek and North Fork. A. D. Hughes is manager.

HYPOTHEEK (Kingston)—Mine operations completely suspended account of defective hoisting cable. New cable put on last January. Strands began to break almost immediately, and damage has now reached a point to render operation unsafe. New cable can be secured only after approval of war board. Red tape may delay arrival. New discovery on 1100 level.

SUNSET (WALLACE) — Owned by Senator W. A. Clark. Shaft sunk 1000 ft., and levels at 200-ft. intervals have exposed large bodies of low-grade zinc-lead ore. On the 1000 level drift east opened up best ore found, mostly lead. Now planning to start tunnel from Beaver Creek to reach orebody 1000 ft. below bottom of shaft. Portal to be within a mile of railroad.

MICHIGAN

Copper

OSCEOLA (Houghton)—Man shortage alone interferes with product of Kearsarge. Old Osceola maintaining output.

LAKE SUPERIOR—Copper stocks accumulation of better than 12,000,000 lb. refined copper on the docks waiting for opening of navigation.

INDIANA (Houghton)—Suspension of operations due to lack of funds. Present plans do not contemplate reopening Indiana until the end of the war.

FRANKLIN (Houghton)—Shaft No. 2 at the 18th level has opened shoot of copper better than the average. No. 1 shaft furnishes 1000 tons ore daily.

COPPER RANGE (Houghton)—Increased capacity now available at Baltic stamp mill. Steel balls replaced pebbles in regrinding mills, working satisfactorily on amygdaloid rock.

CALUMET AND HECLA (Calumet)—Pounds copper production in February; Ahmeek, 2,029,893; Allouez, 643,426; C. & H., 6,137,485; Centennial, 204,568; Isle Royale, 1,148,129; La Salle, 136,877; Osceola, 1,408,457; Superior, 146,070; White Pine, 222,418. Total, 12,077,320. Completion of 10,000-kw. power house at Lake Linden and completion of new office building is only construction contemplated this year.

MINNESOTA

Mesabi Range

M. A. HANNA CO. (Mountain Iron)—Exploration work at the Hanna pit suspended, and instead work to start immediately on shaft of new Pilot mine, a Great Northern Iron Ore property, east of Hanna.

SECTION THIRTY MINING CO. (Ely)—Several buildings purchased from Swallow Hopkins Lumber Co. site at Winton and have been moved across ice to mining location.

HELMER MINE (Buhl)—Taken over by Cleveland Cliffs Iron Co. with some Great Northern Iron Ore properties the first of the year. To house forty families on the road between Deacon and Helmer mines. A machine shop, warehouse and office also to be built. Work on shaft to begin immediately. Duluth Diamond Drill Co. has had two drills at work on the Great Northern lands. Frank Gleason, superintendent.

LA RUE MINE (Tower)—Taken over by Coats and Tweed. Property on Armstrong Bay. Will continue sinking shaft. Now at 195 ft. Two diamond drills operated by Cole & McDonald Exploration Co., of Virginia, are testing property. The Duluth & Iron Range R.R. Co. is surveying line in from Murray and expects to start construction in spring. H. E. Wallbank is superintendent, and is expected to ship in 1918.

KINGSTON MINING CO (Eveleth)—Estimated that 170,000 tons of ore will be shipped from the Fault No. 2, the Jean, and the Rutland mines during coming season. Three bodies of ore on the Fault property, two being mined underground and the third stripped; mine and pit east of Adams openpit; the Jean is back of electric light plant and Rutland is west of Adams Ave. on North Hays St. The Pickands-Mather Co. is sales agent for this ore.

MONTANA

Deer Lodge County

BLUE EYED NELLIE (Anaconda)—Tunneling under supervision of A. W. Patterson, of Spokane, to tap vein at depth 700 ft. which 30 years ago was one of famous silver-lead producers in state. Tunnel to prospect hill for other veins and a number of ore-bearing stringers have been cut by tunnel, now 800 ft. long.

Fergus County

BARNES KING DEVELOPMENT CO. (Kendall)—Annual meeting held Mar. 6. Old board was re-elected, headed by C. W. Goodale, of Butte.

Jefferson County

WILLARD GROUP (Beaver Dam)—Four ft. of ore in 100-ft. shaft. Silver, lead and zinc.

MOUNTAIN STATES CO. (Warm Springs)—The 250-ft. shaft repaired 50 ft. deep. Machinery arriving from Denver.

AMALGAMATED SILVER MINES (Lump Gulch)—Shaft 250 ft. deep will continue to 300-ft. station.

Lewis and Clark County

LEE MOUNTAIN MINE (Rimini)—Developing lower level with crew of 30 men.

ST. LOUIS CO. (Marysville)—Development in Drumlummon mine begun in lower tunnel.

CRUSE CON. (Helena)—New 80-hp. boiler in place. Shaft to be sunk below present depth of 150 feet.

BYRNES-COFFEE MINE (Helena)—Under option to purchase by Capt. A. B. Woolvin, of Duluth, Minn.

BARNES-KING CO. (Marysville)—Discovered rich free-gold ore in winze of Gloster mine. Ore uncovered in west drift of 650 level Shannon mine.

PLACER MINING (Helena)—City council issued permit to Gilman Bullard and associates to engage in placer mining on city property abutting on South Main St., on conditions that lessees furnish bond of $10,000 and that work be finished by July 31. City to receive 10% of gross revenue derived from operations.

Silverbow County

BUTTE & SUPERIOR (Butte)—February output was 12,500,000 lb. of zinc and 250,000 oz. of silver.

ANACONDA (Butte)—February copper production from company's mines was 24,100,000 lb., or 884,000 lb. short of January output, owing chiefly to fewer working days. On Sunday, Mar. 3, all copper mines were closed for two shifts to allow smelters at Anaconda and Great Falls to decrease accumulated surplus ore. Work resumed at Alice mine with a crew of 150 men. Production to be 250 tons of zinc ore per day until lower levels are unwatered, when output will be increased. Lexington resumed operations with 200 men. New copper rod and wire mill at Great Falls expected to be ready May 1. Mill to have capacity of 200,000 lb. of copper rods and 85,000 lb. of copper wire per shift of eight hours.

NEVADA

Nye County

MANHATTAN RED TOP (Manhattan)—Drift following fault cut small fissure, which will be followed.

WHITE CAPS EXTEN. (Manhattan)—About 50 ft. limestone crosscut on 400 level. No change yet in formation.

UNION AMALGAMATED (Manhattan)—Station in Earl shaft completed on 600 level and shaft sinking resumed from bottom, 22 ft. below. Ready to proceed with development of 600 level.

TONOPAH EXTENSION (Tonopah)—Receipts from operations of mine and mill for January, $93,541.89; current expenses, $84,033.52; operating profit, $9,508.37. W. G. Benham, secretary.

WHITE CAPS (Manhattan)—Formation in west drift, 359 ft. from shaft unchanged. Southwest crosscut from 506 sill emerged from barren ground into a face of high-grade ore. Recent estimates at the mill indicate an extraction of 88.7%.

MANHATTAN CON. (Manhattan)—Shaft 20 ft. below 500-level station, which has been completed. Black "Morning Glory" limestone reached in last 5 ft., showing base sulphides. Flow of water doubled, but can still handle by bailing.

Storey County

OPHIR (Virginia)—Milled at the Mexican mill 111 tons assaying $11.19 a ton.

CALEDONIA (Gold Hill)—Work continued on repair of 1200 level and in removing air pipe, track and other materials from unused drifts.

SIERRA NEV. (Virginia)—On 2500 level advanced drift north distance 15 ft., face showing 12 in. of quartz on footwall assaying $12.70 per ton at top, and 8 in. assaying $104.64 per ton at bottom; with high silver values.

JACKET (Gold Hill)—Repairs in Jacket shaft; 300 level advanced 13 ft.; 10 cars low-grade ore saved. Sinking and timbering winze in surface tunnel advanced three feet. Stoping and drawing 63 cars low-grade ore from No. 5 west gloryhole. Mill working on new equipment and necessary repairs to building; old cyanide plant operated; one bar bullion shipped.

CON. VIRGINIA (Virginia)—On 2000 level extracted 60 tons of ore averaging $17 and 16 tons averaging $20.39 per ton. Reopened old connection with Ophir incline distance 47 ft., making total in good condition 437 ft.; to be used as main tramway to Union shaft. On 2700 level, northeast drift from crosscut from 2500 winze advanced eight feet, face in porphyry, clay and quartz with occasional fair assays.

UNION CON. (Virginia)—Total week's production, 461 tons, general assay value $24.36 per ton. A 6-in. vein sampling $67.63 uncovered on foot wall of crosscut from southeast drift on 2300 level. Face shows porphyry in the center with low-grade quartz on hanging wall and high-grade vein on footwall. From 2400 level, 70 tons sampled $13.67 per ton; 25 tons, $30.86; 25 tons, $9.71; 14 tons, $16.07. From 2500 level sent to mill 231 tons sampling $30.27 per ton; also extracted 35 tons sampling $19.36 per ton. Milled at Mexican mill 401 tons of average assay value $24.36, and 60 tons of wedge rock sampling $4.37 per ton.

NEW MEXICO

Grant County

CARLISLE MINING CO. (Steeple Rock)—Property has reverted to owners, and company in a state of bankruptcy.

SILVER HILL (Steins)—Shipments being made to Coffeeville, Kan. Contemplate installation of drills and compressor. Fred P. Davy is lessee.

85 MINING CO. (Lordsburg) — To suspend production until completion of installation of new hoist and mill. Expect to resume in April.

BOSTON-EMERALD Co. (Lordsburg)—Reorganized under present name by operators of the Atwood mine. Draining shaft and expect to complete mine equipment for operations by Apr. 1.

NEW YORK

Sullivan County

ST. NICHOLAS ZINC MINE (Summitville)—Leased to company operating on royalty basis. Additions and improvements in mills under way. Mine development has opened up new orebodies of zinc and lead sulphide. Walter J. Pierce, 43 Exchange Place, New York, is at the head of leasing syndicate. John H. Banks is in charge.

NORTH CAROLINA

Franklin County

ROCHESTER - CAROLINA M. CO. (Rochester, N. Y.)—Organized for purpose of acquiring and operating several mica properties in Franklin County and in the Burningtown Gap region. C. E. Bonsteele, of Troy, N. Y., is organizing the company.

Lincoln County

CHIEF CONSOLIDATED (Eureka)—Property able to ship unusually large tonnage week ended Feb. 22. Since beginning of year held down to daily average of about 200 tons.

CRANBERRY IRON CO. (Johnson City, Tenn.)—Has recently taken an option on a magnetic iron property near Lincolnton. A magnetic survey of the property has been made, and operations are planned.

SOUTH DAKOTA

Lawrence County

FREMONT (Lead)—Concentration to treat lower-grade manganese ore contemplated.

HOMESTAKE (Lead)—Changes from steam to electric power being made at different plants. High-pressure air compressor electrified and similar change under way at the Brig hoist. New modern change house being constructed at B. and M. shaft.

DEADWOOD LEAD AND ZINC (Deadwood)—100-ton Portland Filter added to mill equipment and used in preliminary treatment of "blue sulphide ores" before cyanidation. Cake from filter after washing is mixed with oxidized ores and treated by cyanide. Good results obtained.

UTAH

Juab County

MAMMOTH (Mammoth) — Enlarging shaft. Shipments, 14 cars week ended Feb. 22.

TINTIC STANDARD (Eureka)—Report filed with state board of equalization shows a valuation of $35,259 and net proceeds of $114,208 during 1917.

NORTH BECK (Eureka)—Shaft down 700 ft.; when 1000 ft. reached crosscutting to be undertaken. E. J. Raddatz, of Tintic Standard, interested.

CHIEF CONSOLIDATED (Eureka)—New unit 2500-cu.ft. compresser added, doubling previous capacity. Company drove 20,000 ft. of development workings in 1917.

GRAND CENTRAL (Mammoth)—New orebody being developed by raising from 2000 level. Appears to be entirely new ore channel between east and west veins. February shipments, 60 cars.

EAGLE & BLUE BELL (Eureka)—February shipments, 80 cars. Considerable development work accomplished. February good month. Mine could produce more. Prospecting on 200 level to be started soon. Expect ore 300 ft. from shaft.

UTAH MINE (Fish Springs)—Foundations for new mill under way. To treat large tonnage of low-grade ore on dump accumulated from many years operation. Only high-grade ore previously shipped, on account of 90-mile wagon haul to railroad at Oasis. Ore silver-lead, and shipping grade usually carried 100 oz. and upward in silver. Pumps recently installed in mine. Situated between Deep Creek and Dugway districts.

Salt Lake County

BINGHAM MINES (Bingham)—Dividend No. 4 of 50c. per share declared payable Apr. 1.

UTAH CONSOLIDATED (Bingham)—Quarterly dividend of 50c. per share declared payable Mar. 25.

ALTA CONSOLIDATED (Alta)—Working in four places; developing in two points. Two cars available; delayed on account hauling conditions.

COLUMBUS-REXALL (Alta)—Ore being mined from west drift from the No. 4 raise, averaging well in copper. Shipments good; handicapped by bad roads.

Summit County

JUDGE M. & S. CO. (Park City)—New orebody stated not to be near New Quincy lines, but well within center of Daly-Judge.

IOWA COPPER (Park City)—Developing and storing ore awaiting better shipping conditions. Shaft sinking to be resumed and crosscut to be driven on 200 level. Dave Scott, superintendent.

ONTARIO SILVER (Park City)—Orebody of considerable size and value indicated on 1700 level in sufficient development to determine extent or whether continuation of ore on 1600 level.

SILVER KING CONSOLIDATED (Park City)—Quarterly dividend of 10c. per share declared, payable Apr. 1 and amounting to $70,000 and bringing total of dividends to $1,567,705. Tunneling toward recently acquired California-Comstock, in Thaynes Canyon, including D. & M. and other holdings.

Tooele County

POLE STAR COPPER (Gold Mill)—Shipping-grade copper ore opened in shaft at 300 ft.

WOODMAN MINING (Gold Hill)—Body of shipping-grade copper ore being developed 50 ft. below main tunnel. Shipments being made from other places.

CANADA

British Columbia

CONSOLIDATED M. & S. CO. (Trail)—Has declared a dividend of $261,935, to be disbursed Apr. 2.

LARSON CLAIMS (Kalso)—Seattle capitalists purchased 200 acres of manganese ore claims from Andrew G. Larson, of Spokane, and A. J. Curle, of Kalso. Three valuable deposits uncovered. Large orders for equipment have been placed.

Ontario

HOHENHAUER (Kirkland Lake)—Temiskaming option has been abandoned.

CANADIAN KIRKLAND (Kirkland Lake)—Shaft on No. 2 vein down 40 ft., where vein is 7 ft. wide, with ore stated to average $21 per ton.

WALSH (Gowganda)—Property being operated by Crown Reserve under option. Shaft reached 100 level, where station is being cut.

ELY-SCOTT SYNDICATE (Gowganda)—Vein of barite averaging 8 ft. in width uncovered and reported to be of exceptional purity.

CHAMBERS-FERLAND (Cobalt)—In drifting on one of the veins in proximity to Nipissing boundary a pocket of high-grade ore about 4 in. wide has been encountered.

TRETHEWEY (Cobalt)—Three Groen flotation machines ordered; will handle 150 tons per day. Impounded tailings amount to 66,000 tons, estimated to contain 313,000 oz. silver.

CROESUS (Munro Township)—Equipment of small mill readjusted and now in full operation, treating about 40 tons per day. Recovery stated to average over $50 per ton.

TOUGH OAKES (Kirkland Lake)—Vein found in crosscutting on 350 level is stated to be good grade across a width of 6 ft., with a streak carrying high-grade gold content.

O'DONALD CLAIMS (Boston Creek)—Lies between Boston Creek mine and Patricia Syndicate property. Has been purchased by Detroit interests, and development to be begun immediately.

WALDMAN (Cobalt)—At shaft No. 3 crosscutting on 100 level to connect No. 2 shaft. Progress made, 60 ft. per day. A crosscutting also near Eastern boundary to pick up veins found on the Silver Bar, adjoining.

LAKE SHORE (Kirkland Lake)—New mill completed and being tuned up for steady operations 60 tons per day to be treated in the meantime, but provision made for adding to equipment required. Large tonnage broken in stopes.

PETERSON LAKE (Cobalt)—Underground work temporarily suspended owing to labor shortage. Some men employed on construction of new mill, expected to be in operation by middle of June for slime and jig tailings in Cart Lake section.

MEXICO

Chihuahua

A. S. & R. Co. (Chihuahua)—This company is preparing to reopen its plants in this state.

Sonora

GREEN CANANEA (Cananea)—Production in February was: Copper, 3,960,000 lb.; silver, 115,570 oz.; gold, 1058 oz.

CHILE

Antofagasta

CHILE EXPLORATION CO. (Chuquicamata)—Copper production in January, 8,358,274 lb.

PERU

CERRO DE PASCO (Cerro de Pasco)—Blister copper production in February, 5,332,000 lb.

CHOSEN

ORIENTAL CON. M. CO. (Unsankinko)—Mill gold clean-up in February valued at $124,255

The Market Report

SILVER AND STERLING EXCHANGE

Mar.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Mar.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
14	4.7525	86½	43	18	4.7525	87	43½
15	4.7525	86½	43	19	4.7525	87½	43¾
16	4.7525	86½	43	20	4.7525	88½	43¾

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Mar.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
14	*23½	†	7½ @7½ 7½	7.05 @7.10 7.10	7.35 @7.40 7.35
15	*23½	†	@7½ 7½	@7.20 7.05	@7.40 7.35
16	*23½	†	@7½ 7½	@7.10 6.95	@7.40 7.30
18	*23½	†	@7½ 7½	@7.05 6.95	@7.35 7.20
19	*23½	†	@7½ 7½	@7.05 7	@7.25 7.00
20	*23½	†	@7½	@7½	@7½

* Price fixed by agreement between American copper producers and the U. S. Government, according to official statement for publication on Friday, September 21, 1917.

† No market.

The above quotations (except as to copper, the price for which has been fixed by agreement between American copper producers and the U. S. Government, wherein there is no free market) are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars.

We quote electrolytic cathodes at 0.05 to 0.10c. below the price of wirebars, cakes and ingots.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17.5c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 13c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Mar.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
14	110	110	125	322	320	29½	54
15	110	110	125	320	319	29½	54
16	...	...	...	...	...	...	...
18	110	110	125	320	319	29½	54
19	110	110	125	320	319	29½	54
20	110	110	125	...	...	29½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at $4.7515. £29½ = 6.2576c.; £54 = 11.4545c.; £110 = 23.3333c.; £125 = 26.5151c.; £260 = 55.1513c.; £280 = 59.3937c.; £300 = 63.6362c. Variations, £1 = 0.2121205c.

Metal Markets

NEW YORK—Mar. 20, 1918

The only interesting features of this week were the exhibition of distinct weakness in zinc and some weakness, but more confusion, in lead. Both copper and tin were in statu quo.

Copper—Supplies of crude copper are arriving more freely at the refineries, and other difficulties are being ameliorated. The demand continues very large. Otherwise, there is nothing to report.

In our report of the copper market last week we inadvertently made a misstatement, through a pure slip of the pen, in saying that "the present monthly production is not more than two-thirds the average rate in 1917." We should have said four-fifths.

Copper Sheets are quoted at 31½c. per lb., f.o.b. mill, for hot rolled, and 1c. higher for cold rolled. Copper wire is quoted at 26½c. f.o.b. mill, carload lots.

Tin—The situation remains unchanged. In naming an arbitrary price for Straits tin, for statistical purposes, for the month of February, the problem is much more difficult than it was for January. In January data respecting the transactions of jobbers were available, but in February their supplies were pretty much exhausted. About the only guide to the wholesale market in February is the transactions in lower grades of tin, most of which were in tin of 99% grade. Such transactions, on the basis of 10,000 lb. lots, seem to have been done at an average of about 80c. per lb. More or less evidence, such as bids for Straits tin, occasional transactions in Banka, etc., indicates that the premium for Straits tin might reasonably be considered to be at least 12c. per lb. above the price for 99% grade as an average for the month. For statistical purposes we adopt 92c. as the average spot price for Straits tin in New York in February, 1918.

Lead—There were moderate transactions and much confusion in this market. One or more small producers seem to have pressed metal for sale in St. Louis, accepting prices materially lower than previous quotations. Lead for shipment was offered in Eastern markets at corresponding declines. Advantage seems to have been taken of the situation to start something like a bear raid, which was fostered by a rumor that the Government is contemplating fixing the price for lead at 7c. Such a project would naturally scare holders of lead into selling. In fact, there were no intimations from Washington to lend color to such a story. On the contrary, the latest advices were directly to the contrary. And, moreover, it was scarcely common-sense to give credence to any such report coincident with the news of the creation of a new price-fixing board, which had not yet had time to sit at all. There were some good inquiries in the market, both from home and from abroad, with others foreshadowed in the near future, and there were no indications of any real impairment of the fundamental strength in lead. Advices late on Wednesday disclosed a stiffening tendency in St. Louis, with a probability that small producers had disposed of all they cared to sell there, or all they had to sell. A strike at the smelting works of the St. Joseph Lead Co., on Mar. 16, which closed it down, passed almost without notice in the market.

Zinc—The market is dull and weak, with small sales from day to day. Some spelter was sold at 7¼c. on Mar. 19, after which numerous sellers who tried to get that price found that some one else was taking the business at lower prices. On Mar. 20 the market was distinctly weaker.

Zinc Sheets—$15 per 100 lb., unchanged.

Other Metals

Aluminum—No price other than the Government price of 32c. per lb. for lots of 50 tons or more quoted. The ingot market is very uncertain.

Antimony—This market is again weaker, being under the shadow of the large stocks that still exist. We quote 13c. for spot and 12c. for futures, c.i.f., in bond.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at $3.35 per lb. for wholesale lots—500 lb. and over. The market is quiet.

Cadmium—This metal is quoted at $1.40 @1.75 per lb., depending on the quantity.

Nickel—Steady at 50c. per lb., premium of 5c. per lb. for electrolytic.

Quicksilver—Unsettled at $115@120. On Mar. 19 there was a meeting in San Francisco between dealers and representatives of the Government, at which purchases are said to have been negotiated at $115. However, San Francisco reports the market this morning, by telegraph, at $114, steady.

Gold, Silver and Platinum

Silver—Silver closes firm at an advanced figure, owing to the demand for the East. The price, after remaining steady a few days at 43d., has been marked up to-day to 43¾d. February shipments from San Francisco were 4,423,000 ounces.

Although reports from Washington are to the effect that an agreement has been reached between the Treasury and Congressional leaders on the legislation about to be introduced in Congress covering Government dealings in silver during the war, opinion is expressed by those in touch with the silver situation that there will be considerable delay before the Government can proceed with its plan of melting down the silver dollars now hoarded to the extent of more than $200,000,000 in the Treasury.

Advices from London indicate a diminution in the reserve stock of silver rupees in India, and a heavy demand for silver from that quarter is expected.

Mexican dollars at New York: Mar. 14, 69½; Mar. 15, 69½; Mar. 16, 69½; Mar. 18, 70; Mar. 19, 70; Mar. 20, 71⅛.

Platinum—The last sales made in the free market were $103 per oz.

Palladium—The market is very strong, with sales reported at $140@150.

Zinc and Lead Ore Markets

Joplin, Mo., Mar. 16—Blende, per ton, high, $66.25; basis 60% Zn, premium, $65 @60; medium to low, $55@45; average basis, $55; calamine, per ton, 40% Zn, $40 @35; average selling prices: Blende, $55.29; calamine, $39.18; all zinc ore, $55 per ton.

Lead: high, $89.90; basis 80% Pb, $88 @86; average selling price, all grades of lead, $85.62 per ton.

Shipments the week: Blende, 11,880; calamine, 611; lead, 1360 tons. Value, all ores the week, $797,230.

Shippers were accorded improved transportation service, and a considerable tonnage, long ago purchased, was moved this week. It has no bearing on the purchases of the week, which were light. Smelters are following up the plan of shipping in trainloads, all of them having cars mislaid this side of their destination. It is roughly estimated that more than a million dollars' worth of ore is "somewhere in transit."

Platteville, Wis., Mar. 16—(By telegraph)—Blende, basis 60% Zn, $60 base for premium grade down to $56 for second grade. Lead ore, basis 80% Pb, $85 per ton. Shipments reported the week were: 3148 tons blende, 94 tons galena, and 1422 tons sulphur ore. For the year to date the totals are: 24,036 tons blende, 1017 tons galena, and 7392 tons of sulphur ore. During the week 3127 tons of blende was shipped to separating plants.

Other Ores

Antimony Ore—Little business reported.

Manganese Ore—The schedule of $1.20 for high-grade metallurgical ore is still in force with most of the buyers, but some ores, including Indian, have been sold at a considerable premium. We quote $1.20@1.30 per unit for 48% grade and upward.

Molybdenite—Situation unchanged, and dealers are not making any quotations.

Pyrites—Spanish lump is quoted at 16c. per unit, on basis of 10s. ocean freight, buyer to pay excess freight and war risk, except that, depending on conditions, concession of 2% of war risk may be allowed. Market is very unsettled on account of the impending action of the Shipping Board. Washington proposes to limit the movement of pyrites from abroad to 125,000 tons during the ensuing six months; shipments to be limited to 40,000 tons the first month,

30,000 the second, 20,000 the third, 15,000 the fourth, 10,000 the fifth, and 10,000 the sixth. It is expected that domestic deposits will be exploited and production stimulated sufficiently to supply the market.

Tungsten Ore—This market is fairly active. Business in scheelite was done at $24 and in wolframite, at $20@24, according to grade.

Iron Trade Review

PITTSBURGH—Mar. 19

Commercial demand for steel products is not broadening to the extent expected. For steel products other than oil-country goods, small spikes, standard steel pipe and sheets, there is scarcely any demand except in connection with the war. The tonnage demand for sheets is not large, but is insistent, because the mills are well sold up, with their limited output and the large tonnage required by the Government.

While the important conference between the War Industries Board and the general steel committee will occur to-morrow, in Washington, it is regarded improbable that any official announcement as to prices to obtain after Mar. 31 will be made before next week. Practically the consensus of opinion in Pittsburgh is that there will be no changes in prices; certainly no important changes. The various arguments that have appeared in the public prints to the effect that higher prices should be allowed are regarded here as representing tactics to offset demands likely to be made by Washington for lower prices. The argument that plates should be advanced from 3.25c. to 3.75c. because there is little profit to detached mills in rolling plates from slabs purchased at the set price of $50 per gross ton, receives little attention in Pittsburgh, it being pointed out that mills that roll slabs also roll plates, and that advancing the price of plates would be no inducement to them to sell more slabs, which have been very scarce under the present schedule of prices.

Production and shipments of finished steel continue to increase, but rather slowly, as car supplies are still light.

Pig Iron—Merchant furnaces have been operating at about 80% of capacity in the last two or three weeks, and with the heavier coke shipments of the last fortnight are likely to operate at a still better rate, and 100% operation may come soon. If so, the scarcity of pig iron is likely to disappear. The foundry melt is greatly reduced, owing to light demand for castings. Most furnaces are fully sold up to July 1, and fairly well sold up to the end of the year, on contract, but it is not certain that consumers will require full contract deliveries. The market remains at the set prices: Bessemer, $36.30; basic and No. 2 foundry, $33; malleable, $33.50; forge, $32, f.o.b. furnace, freight from Valley furnaces to Pittsburgh being 95c.

Steel—There is a moderate demand for soft steel billets and sheet bars, with practically no offerings. Shell-discard steel is in fair supply, but with limited demand. On account of shortage of scrap, mills are melting a great deal of their discard material, and some mills are rolling considerable quantities into light rails, the detached re-rolling mills having correspondingly less trade. Prices remain: Billets, $47.50; small billets, $51; slabs, $50; sheet bars, $51; rods, $57.

Ferroalloys

Ferromanganese—Two or three good-sized transactions for the second half are reported, at the full price of $250, delivered, which is also the market for prompt.

Coke

Connellsville—Shipments of Connellsville coke last week probably exceeded 350,000 tons, against 335,000 tons the preceding week and less than 300,000 tons in preceding weeks of the year. Car supply on the Monongahela R.R. yesterday was 60%, with a promise of 80% to-day, foreshadowing as good shipments this week as last, if not better. About 375,000 tons a week seems to be required for 100% operation of the blast furnaces, depending on the region. Coke loaded in P. & L. E. cars is usually available in the open market, at the set price of $6, but coke in Pennsylvania and B. & O. cars remains scarce. Some additional coke is to be diverted east by the Fuel Administration, to take care of concerns working on Government orders.

STOCK QUOTATIONS

N. Y. EXCH.†	Mar. 19
Alaska Gold M	1⅛
Alaska Juneau	2
Am.Sm.& Ref.,com.	79
Am. Sm. & Ref., pf.	105½
Am. Sm. Sec., pf., A	90
Am. Zinc	13¾
Am. Zinc, pf	42⅜
Anaconda	63
Batopilas Min	1
Bethlehem Steel	79
Bethlehem Steel, pf.	89
Butte & Superior	20½
Butte Cop. & Zinc	9
Cerro de Pasco	31½
Chile Cop	15½
Chino	40
Colo.Fuel & Iron	38
Crucible Steel	63¾
Crucible Steel, pf	86
Dome Mines	8
Federal M. & S.	11
Federal M. & S., pf.	30
Great Nor., ore ctf.	27
Greene Cananea	40½
Gulf States Steel	88½
Homestake	81
Inspiration Con.	44½
International Nickel	28⅛
Kennecott	31⅛
Lackawanna Steel	78
Mexican Petrol	92¼
Miami Copper	30½
Nat'l Lead, com.	55
National Lead, pf.	100
Nev. Consol.	18⅛
Ontario Min	7⅞
Ray Con	23⅛
Republic I.&S.,com.	79
Republic I. & S., pf.	97⅞
Sloss-Sheffield	53½
Tennessee C. & C.	16
U. S. Steel, com.	90⅛
U. S. Steel, pf.	109½
Utah Copper	78⅛
Va. Iron C. & C.	66

N. Y. CURB†	Mar. 19
Big Ledge	1⅛
Butte & N. Y.	1
Butte Detroit	.59½
Caledonia	.45
Calumet & Jerome	1⅛
Can. Cop. Corpn	2
Carlisle	‡2
Casboy	.09½
Con. Ariz. Sm.	2⅛
Con. Coppermines	5½
Con. Nev.-Utah	‡⅛
Emma Con	⅛
First Nat. Cop.	2
Goldfield Con.	‡.40½
Goldfield Merger	‡.04½
Greenmonster	‡.75
Hecla Min.	4
Howe Sound	‡4½
Jerome Verde	‡½
Kerr Lake	5.30
Louisiana	‡.50
Magma	‡37
Majestic	.31
Marsh	.06½
McKinley-Dar-Sa.	.44
Milford	11½
Mohican	‡.25
Mother Lode	.33
N. Y. & Hond.	‡12½
Nipissing Mines	8½
Nixon Nevada	1.03½
Ohio Cop.	1
Rawley	‡2½
Ray Hercules	4½
Richmond	‡.56
Rochester Mines	.35
St. Joseph Lead	15
Standard S. L.	⅛
Stewart	.25
Success	.12½
Tonopah	3½
Tonopah Ex.	1⅛
Tribullion	‡.31½
Troy Arizona	‡.18
United Cop.	‡⅛
United Verde Ext.	38
United Zinc	‡2½
Utica Mines	‡.08

SAN FRAN.*	Mar. 19
Alta	.02
Andes	.18
Best & Belcher	.02
Caledonia	.06
Challenge Con.	‡.03
Confidence	.04
Con. Virginia	.29
Gould & Curry	.01
Hale & Norcross	.02
Jacket-Cr. Pt.	.07
Mexican	.14
Occidental	‡.60
Ophir	.09
Overman	.02
Savage	.04
Sierra Nevada	.14
Union Con.	1.00
Utah Con.	‡.01
Belmont	3.15
Jim Butler	.61
MacNamara	.11
Midway	‡.08
Mont.-Tonopah	.10
North Star	.05
Rescue Eula	.08
West End Con.	.77
Atlanta	.11
Booth	.04
Comb. Frac.	‡.02
D'field Daisy	‡.02
Florence	.13
Jumbo Extension	.14
Kewanas	.07
Nevada Hills	.04
Nevada Packard	‡.25
Round Mountain	.35
Silver Pick	.04
White Caps	.49
Big Jim	‡.75
United Eastern	4.62

BOSTON EXCH.*	Mar. 19
Adventure	1
Ahmeek	80½
Algomah	.25
Alloucz	50½
Ariz. Com., ctfs.	12½
Arnold	.20
Bonanza	.20
Butte-Balaklava	.26
Calumet & Ariz.	69½
Calumet & Hecla	432
Centennial	13½
Copper Range	44½
Daly West	1½
Davis-Daly	5½
East Butte	9½
Franklin	5½
Granby	75
Hancock	8½
Hedley	12
Helvetia	.15
Indiana	.75
Isle Royale	21
Keweenaw	1½
Lake	5½
La Salle	2½
Mason Valley	5½
Mass	‡6½
Mayflower	1½
Michigan	2
Mohawk	62
New Arcadian	1½
New Idria	16
North Butte	15
North Lake	.95
Ojibway	1½
Old Dominion	‡40½
Osceola	59
Quincy	71
St. Mary's M. L.	51
Santa Fe	1
Seneca	10½
Shannon	4½
Shattuck-Ariz.	16½
So. Lake	1½
So. Utah	.12
Superior	4½
Superior & Bost.	2½
Trinity	3½
Tuolumne	⅛
U. S. Smelting	44
U. S. Smelt'g, pf.	45½
Utah Apex	2
Utah Con.	10
Utah Metal	2½
Victoria	2½
Winona	1½
Wolverine	‡29½
Wyandot	1

BOSTON CURB*	Mar. 19
Alaska Mines Corp.	.20
Bingham Mines	‡9½
Boston Ely	.83
Boston & Mont.	.62
Butte & Lon'n Dev.	.20
Calaveras	1⅛
Calumet-Corbin	‡.01
Chief Con.	2
Cortez	.10
Crown Reserve	.20
Crystal Cop.	.52
Eagle & Blue Bell	2
Gila Copper	‡17
Houghton Copper	.75
Intermountain	‡.70
Iron Cap, Com.	19
Mexican Metals	.46
Mines of America	1⅛
Mojave Tungsten	.06
Nat. Zinc & Lead	.27
Nevada-Douglas	.85
New Baltic	.90
New Cornelia	17
Oneco	.20
Pacific Mines	‡.35
Rex Cons.	.10
Yukon Gold	1

SALT LAKE*	Mar. 18
Bannack	‡.26
Cardiff	3.90
Colorado Mining	‡.08
Daly	1.50
Daly-Judge	‡6.00
Empire Copper	‡1.10
Gold Chain	‡.08
Grand Central	‡.35
Iron Blossom	‡.37½
Lower Mammoth	‡.03
May Day	‡.02½
Moscow	‡.02
Prince Con.	.53
Rico Wellington	.15½
Silver-King Coal'n	‡2.67
Silver King Con.	1.95
Sioux Con.	.04
So. Hecla	.64
Tintic Standard	‡1.35
Uncle Sam	.01
Walker Cop.	1.50
Wilbert	‡.08
Yankee	‡.05

TORONTO*	Mar. 18
Adanac	.09
Bailey	.04½
Beaver Con.	.26½
Chambers Ferland	.10
Coniagas	3.25
Hargraves	.07
La Rose	.46
Peterson Lake	.09½
Temiskaming	.26½
Wettlaufer-Lor.	.05
Davidson	.34½
Dome Exten.	.09½
Dome Lake	.25
Hollinger	5.05
McIntyre	1.38
Newray	.19
Porcu. Crown	.15
Teck-Hughes	.49
Vipond	.22½
West Dome	.13½

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Mar. 19
Cresson Con.	4.37½
Doctor Jack Pot	.03½
Elkton Con.	.04
El Paso	.12
Gold Sovereign	.02
Golden Cycle	1.61
Granite	.34
Isabella	.05½
Mary McKinney	.05
Portland	1.00
United Gold M.	.15
Vindicator	.35

LONDON	Feb. 28		
Alaska G. F.	£0	10s	6d
Burma Corp.	4	6	3
Cam & Motor	0	11	6
Camp Bird	0	8	0
El Oro	0	9	9
Esperanza	0	10	0
Mexican Mines	5	12	6
Min. Corp. Can.	0	16	9
Nechi, pfd.	0	11	0
Oroville	0	19	9
Santa Gert'dis.	0	13	6
Tomboy	0	19	0

* Bid prices. † Closing prices. ‡ Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1916	1917	1918	1916	1917	1918
Jan.	56.775	75.630	88.702	26.960	36.682	44.356
Feb.	56.755	77.585	85.716	26.975	37.742	42.792
Mar.	57.935	73.861		27.597	36.410	
April	64.415	73.875		30.662	36.963	
May	74.269	74.745		35.477	37.940	
June	65.024	76.971		31.060	39.065	
July	62.940	79.010		30.000	40.110	
Aug.	66.083	85.407		31.498	43.418	
Sept.	68.515	100.740		32.584	50.920	
Oct.	67.855	87.332		32.361	44.324	
Nov.	71.604	85.891		34.192	43.584	
Dec.	75.765	85.960		36.410	43.052	
Year	65.661	81.417		31.315	40.851	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1917	1918	1917	1918	1917	1918
Jan.	28.673	23.500	131.921	110.000	142.895	125.000
Feb.	31.750	23.500	137.895	110.000	148.100	125.000
Mar.	31.481		136.750		151.000	
April	27.935		133.842		147.158	
May	28.788		130.000		142.000	
June	29.962		130.000		142.000	
July	26.620		128.409		140.409	
Aug.	25.380		122.391		137.000	
Sept.	25.073		117.500		135.250	
Oct.	23.500		110.000		125.000	
Nov.	23.500		110.000		125.000	
Dec.	23.500		110.000		125.000	
Year	27.180		124.892		138.401	

Tin	New York		London	
	1917	1918	1917	1918
January	44.175	85.500	185.813	293.227
February	51.420	92.000	198.974	311.525
March	54.388		207.443	
April	55.910		220.171	
May	63.173		245.114	
June	62.053		242.083	
July	62.570		242.181	
August	62.681		243.978	
September	61.542		244.038	
October	61.851		247.467	
November	74.740		274.943	
December	87.120		298.556	
Av. year	61.802		237.563	

Lead	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	7.626	6.782	7.530	6.684	30.500	29.50
February	8.636	6.973	8.595	6.899	30.500	29.50
March	9.199		9.120		30.500	
April	9.288		9.158		30.500	
May	10.207		10.202		30.500	
June	11.171		11.123		30.500	
July	10.710		10.644		30.500	
August	10.594		10.518		30.500	
September	8.680		8.611		30.500	
October	6.710		6.650		30.500	
November	6.249		6.187		30.500	
December	6.375		6.312		30.500	
Year	8.787		8.721		30.500	

Spelter	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	9.619	7.836	9.449	7.661	48.329	54.00
February	10.045	7.814	9.875	7.639	47.000	54.00
March	10.300		10.130		47.000	
April	9.459		9.289		54.632	
May	9.362		9.192		54.000	
June	9.371		9.201		54.000	
July	8.643		8.473		54.000	
August	8.360		8.190		54.000	
September	8.136		7.966		54.000	
October	7.983		7.813		54.000	
November	7.847		7.672		54.000	
December	7.685		7.510		54.000	
Year	8.901		8.813		52.413	

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron, Pgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1917	1918	1917	1918	1917	1918
January	$35.95	$37.25	$30.95	$33.95	$30.95	$33.95
February	36.37	37.25	30.95	33.95	30.95	33.95
March	37.37		33.49		35.91	
April	42.23		38.90		40.06	
May	46.94		42.84		43.60	
June	54.22		50.05		50.14	
July	57.45		53.80		53.95	
August	54.17		50.37		53.95	
September	46.40		42.24		48.58	
October	37.25		33.95		33.95	
November	37.25		33.95		33.95	
December	37.25		33.95		33.95	
Year	$43.57		$39.62		$40.83	

‡ As reported by W. P. Snyder & Co.